JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES—GAS, &c.

Relative Dangers of Gas and Electricity.

EXCEEDINGLY good service has been done by Herr Schäfer, of Dessau, in the paper we print to-day, on "The Alleged "Dangers of Coal Gas;" and the example he sets may, despite difficulties, tempt to emulation some enthusiast in the gas industry of this country. The only test that can possibly be applied, when dealing with two such general services as gas and electricity, so as to determine their relative degree of danger, is a statistical one. But there at once, in this country, we are faced by the insuperable difficulty of statistical inaccessibility. The leading Insurance Companies are not roped within two Associations, giving publicity to statistics, as are the principal Companies in Germany. Here they are individual units, so stolidly jealous of their own interests and conservative of information, that not even the public advantage will incite them to disclosure. Information, so far as it goes, can, of course, be obtained from the reports of the fire departments of the London County Council and (in cases) other local authorities; but the figures, as a rule, are so indifferently classified that little reliance can be placed upon them. Besides, fire does not constitute the only danger attaching to the production and distribution of gas and electricity; and in these other respects again statistical information is only available in isolated reports—such, for example, as the annual ones relating to factories and workshops.

But if we only take fires attributable to gas or electricity, it is not in accord with equity and fair dealing to adopt any one town as representative of the whole, as in this particular either the gas or the electricity system might be in an abnormal condition of defectiveness. Perhaps an exception might be made of London, where there are three separate gas systems and several electrical ones; but there again the conditions of road disturbance and heavy traffic impose a disadvantage on gas, which disadvantage is more than counterbalanced by the insidious character of fire origination in the case of electricity, which makes it essential for the Fire Insurance Companies, in their own defence, to specify in detail their requirements in respect of installation. Even then their rules (which do not ensure the avoidance, but merely mitigate the chances, of accident) are evaded in these competitive days, and risks are run in an amazing manner. The difficulty is, after a fire in a house or other premises where the electric light is installed, to trace whether or not the installation has had any part in the origination of the fire; and we fear that many mysterious conflagrations that are labelled "cause unknown," would be found, if only the truth could be revealed, to have had their beginning in a congenital or temporary defect in the electric system. We quite anticipate being twitted by the electricians on this expression of opinion; but the fact remains that mysterious fires do not tend to reduction but to multiplication, notwithstanding the growth of precaution with advancing time. Only a few days since, a letter appeared in the "Glasgow Herald," in which the correspondents called attention to the grave risks incurred by shopkeepers, managers, and others entrusted with the responsibility of turning the electric current off at the main switch on closing up. "Not a few disastrous fires," said the writers, "have occurred from neglect to turn the "current off at the main. The troubles such a catastrophe "brings in its train are known only to the sufferers. The "safety of the whole community depends far more on this "precaution than it is aware of." From all which, it will be seen that the difficulties of exact comparative compilation are many. But it is both interesting and instructive to contrast such statistics as are available; and this is what Herr Schäfer has done in his usual cogent and perspicacious style. The object he had before him was to protest against, and disprove, the defamatory allegation that the electricians are so eager to scatter abroad, in view of the prejudicial uneconomy of their system, that gas is a greater peril to life and property than electricity.

Some time ago, we were called upon, by the misuse made by an electrical contemporary of total figures as to fires drawn from the report of the Fire Brigade Committee of the London County Council, to point out that these figures were of no value without considering their relation to the total number of consumers. We applied this test, with the result that the proportion of fires to consumers supplied was greater in the case of electricity than gas. Herr Schäfer has also adopted this—the only right—method of comparison; and he arrives at, for Germany, precisely the same result that we did for London. He takes from the official records both gas and electricity meters and consumption; and incidentally we have a remarkable survey, exhibiting the expanding strength of the gas industry in Germany. According to a conservative estimate, based upon series of statistics collected, the individual places of gas consumption in Germany are at least eight times as numerous as those in which electricity is used; and, again making a conservative computation, at least ten times as much energy is distributed in the form of gas as in the form of electrical current. The further interesting fact is presented by the investigations, that in no case in Germany has the numerical excess of gas-meters decreased from what it was when electricity began to be distributed. This point of numerical superiority cannot be ignored when considering the question of relative danger. While so regarding the figures in the tables as to accidents, it must also be remembered that there has been no classification of the fires and explosions attributed to gas. In these records, in addition to ordinary distributed coal gas, the word "gas" comprises air gas, acetylene, oil gas, producer gas, pressure and suction power plants, and blast-furnace and coke-oven gas-engines; so that the statistical scope is very much broader than in the case of electricity.

Herr Schäfer has not succeeded in getting the statistics for recent years; but it will be seen that, in connection with one group of the associated companies, the number of fires through electrical installations exceeded in 1899 and 1900 those caused by illuminating and fuel gas. The electrical figures for the years named were 204 and 226 respectively; and for gas, 158 and 199. In the case of the other banded societies, defects in electrical installations in 1900 and 1901 numbered respectively 42 and 73; in gas, 57 and 87. The figures for gas have to be divided by the eight or ten previously referred to, as its numerical superiority in respect of places of consumption and volume distributed, in order to establish a relation with the electricity fires. There are some further figures in the article to which we must give prominence—being official ones collected in Berlin. During the decade ending in 1903, the number of gas explosions in the kingdom of Prussia was 1200; property being thereby destroyed to the value approximately of £45,465. The number of fires known to have been originated by electricity was 478; the value of the property destroyed being £117,882. A further 162 fires are stated to have been probably due to electrical causes; the aggregate value of the property in these cases being £258,036. This supplements in a powerful way what we have already said as to the treacherous character of these electrically generated conflagrations. There is smell in the case of coal gas; and a light must be applied to the gas before there can be any damage. With electricity there is no smell; and the assistance of a light is not required before destruction begins. The work of starting the fire is done in secret; and ofttimes it is "well and truly" done before discovery.

Herr Schäfer's paper is so packed with information of value and virtue that we recommend it to the careful consideration of all concerned in the meritorious position that

gas holds among the illuminants in respect of safety. Too long its position as a relatively secure agent to their own commodity has been vilified by electricians without any particularly strong protest. It has been somewhat humorously regarded as evidence of distress in the competition with gas that they should have had to resort to weak and unsupported allegations. One thing is clear, that the much advertised security of electricity has not in this country brought down insurance premiums for premises so lighted; and, on the evidence submitted in the paper under notice, the insurance companies of Germany are not likely to give to electricity any preference over gas. Herr Schäfer deserves to be warmly thanked for both his valuable collection of facts and his manner of dealing with them.

The Better Way.

A PITHY article on "Labour Problems," by Sir Benjamin C. Browne, D.C.L., appeared in the Engineering Supplement to "The Times" last Wednesday. Sir Benjamin is concerned in the engineering trades; and no one who has lot or part in engineering can afford to overlook all the bearings of labour, for perhaps there is no industry that has to rely so much upon regular progression through the hands of labour, from mine to finished structure, as engineering in its divers branches. And the industries contributing to engineering are those in which the strength of labour lies, and which are the most sensitive and the most liable to eruption. In the gas industry, we are not only exposed to the disturbance, vexation, and loss occasioned by the storms of labour in engineering and kindred industries, but there is the large body of labour to deal with that is essential to the manufacture of a commodity that now ranks as a necessity for all communities. Having this concern in labour both within and outside the special industry of gas making, the importance of all labour topics to those who have part in the direction of the industry cannot be too greatly magnified.

Sir Benjamin Browne recognizes, in the consideration he gives to the Trades Disputes Bill, the gravity of the labour problem to such concerns as railways and gas and electric light supplies. In such cases, he says, the Bill will act most prejudicially, inasmuch as "the stoppage of the works is "not so much an injury to the employer as a calamity to "the whole community." While agreeing entirely with the spirit of this statement, we are not prepared to subscribe to any minimizing of the injury to the employer; for the more conscientious he is in exerting himself to the utmost to lighten the calamity to the community, the more he does himself an injury which it takes a longer time to repair than the temporary calamity to the community—for such calamities, bad though they are, are always temporary. Witness, in support, the cost and strain imposed upon the South Metropolitan Gas Company in the memorable battle towards the end of the eighties, when the gas supply was kept going, though occasionally holders and pressures ran low.

Sir Benjamin Browne considers that some provision ought to have been made in connection with the Trades Disputes Bill to save an innocent public from suffering the appalling evils that might arise from a cessation of supplies or of a city being plunged into darkness at the caprice of either a trade union or an obstinate employer; and he suggests, as the Act is sure to be passed, that probably the best way out of the difficulty would be if, in the case of those companies who exist under Special Acts of Parliament, no stoppage of work should be allowed, and every dispute should be compulsorily referred to the Board of Trade for settlement. He admits that this would be a serious evil, but nothing like so great an evil as would be involved in the stoppage of such industries. His suggested method for obviating calamity to communities is, of course, nothing short of compulsory arbitration. While not unfriendly to arbitration, we do not, in the first place, think that—unless the Board of Trade summoned to their aid in such arbitrations men there and then living in the work of the particular industry concerned—such settlements would be of anything more than an evanescent character; and, in the second place, to talk of arbitrations always appears to us to be dealing with capital and labour at a half-way house. What is wanted is to get very much farther back than arbitration. Prevention is now, as it always has been, better than cure. To prevent any evil or trouble, the root must be looked to; and if the root of the relations between capital and labour is sound, and is firmly embedded in peace and goodwill, there will be little call for arbitration. There was much truth in what Sir George Livesey said in the lecture he recently delivered at the Society of Arts, that arbitration never did produce complete satisfaction to all parties; and discontent is always ready to rankle. Co-partnership has provided Sir George with—not another way of dealing with troubles, but with a way of preventing those roughnesses on the industrial road which, appearing, only the ponderous machinery of arbitration, or something worse in method and result, can more or less effectually smooth down. Where difficulties are prevented, there is nothing to arbitrate upon; and therein is to be found a justification for the heading to this comment.

London and the Great Electricity Scheme.

THE formalities connected with the application of the London County Council to Parliament for electricity supply powers, so far as they have to be negotiated at Spring Gardens, were completed last Tuesday, when the Bill was approved, and it was agreed that the seal of the Council should be affixed to a petition for leave to bring in a Bill. Of course, the opponents to this mad scheme have been able up to the present to do nothing more effectual than register their protest, in view of the present constitution of the Council. The inexorable character of Progressivism as known at Spring Gardens stood out in all its boldness on Tuesday, for the resolutions were passed in face of a report by the Finance Committee that should have made any governing body hesitate in the interests of the ratepayers. When the Select Committee last session recommended that the Council should be made the central authority for the purpose of carrying out an inclusive scheme for the supply in London and its environs of electric energy in bulk and for motive power, they did not meditate much over the financial side of the question as it would affect the ratepayers. But this the Finance Committee have done; and the result will not be pleasant reading to the ratepayers. There is no hope whatever that, if Parliament endows the Council with the powers asked for, the ratepayers can escape scot-free. The Finance Committee fear—and fear very seriously—that, during the early years of business incubation, some charge on the rates must be looked for; but the Highways Committee are advised that the charges must be fixed low from the outset, in order to attract business. Now, this necessity for low prices is where the first financial leakage will come in, and that is altogether apart from any consideration as to the problematical extent of the business to be done, upon which and the employment of the capital the price must largely depend. There are also other channels for leakage that those who have been building financial castles in the air as to the future of this proposed undertaking have not taken fairly into account. The scheme involves the purchase of the Borough Councils' electricity concerns, and for the County Council undertaking general supply, as well as bulk and power business. We do not remember that any general supply was really contemplated by the Select Committee last session; but nevertheless the current financial position of the borough undertakings will not give to the ratepayers generally—though in some districts there would be joy in being able to blot out the unpleasant dream of local municipal trading in electricity—any confidence that their working from Spring Gardens will be any more successful. Concentration must of necessity end in uniformity of charge; and the County Council (assuming, of course, the granting of supply powers) could not, without creating hostility, produce uniformity except on the lowest scale of present charges. Result, a further loss of revenue! The charge for public lighting, too, would have to be levelled down; there being at the present time considerable variation of prices in the different boroughs for this purpose. There we have a third channel for loss of revenue.

See what, in the first place, these latter considerations mean for the boroughs that have not up to the present been so foolish as to lumber themselves up with an electricity undertaking. They are to day free from all the financial responsibility in this respect, that other boroughs have incurred. But if the existing borough undertakings pass into the control of the County Council, and losses are incurred in the levelling process, the ratepayers of those boroughs that have been wise enough to keep themselves totally clear of unwise speculation in this connection will have to meet and satisfy a share of the losses. There is something extremely

unrighteous about this. Another aspect of the case is that the County Council have mapped out a large part of the country surrounding their own administrative area within which to supply, but within which they will not be able to collect aid towards liquidating losses. Therefore, it follows that the ratepayers of London will have to bear the losses succeeding the introduction by the Council of supply outside their own territory. The estimates that have been built about this scheme are majestic in their proportions, but their foundations are of a somewhat sandy nature; so that no one can vouch for their security. But notwithstanding the contributions that the whole of the ratepayers will in the early years have to make to support the undertaking, in order to give the users of electricity a cheap supply, the estimates do not contemplate any corresponding relief of the rates when, if ever, a better state of affairs exist. It is not until the scheme is fully developed—in or about the year 1915—that, hypothesis suggests, there will be "a substan- "tial surplus sufficient to secure the financial stability of the "undertaking." This being so, the ratepayers stand a poor chance of freedom from the claims of the undertaking for years to come.

The Finance Committee do not appear, in connection with this scheme, so jealous as aforetime of the interests of the ratepayers. Perhaps they accept a County Council electricity undertaking as inevitable, unless the ratepayers give their representatives a very definite mandate to the contrary next March. However, that may be, the Committee are very mild in their recommendation that "suffi- "cient margin should be allowed to afford all reasonable "safeguards against any charge on the rates except in the "early years of development," without putting in a word for the ratepayers' recompense (nothing more) when things are, if ever, more prosperous with the undertaking. We cannot see the justice of ratepayers generally being charged with a deficiency which they have not helped to create, and more especially as, in the interests of low charges to consumers, the ratepayers have no hope held out to them of being reimbursed. Such a thing could not happen in the case of private enterprise; and in private enterprise the ratepayers have their greatest safeguard against loss. The scheme has the support of the Socialist and Progressive members of the Council; but we cannot divine how it comes within the four corners of their boasted principles. If anyone will suffer pecuniarily, it will be the poor and middle-class ratepayers and tradesmen; and for what purpose?—to give the manufacturers and the moneyed classes of the community cheaper electricity. We cannot reconcile this with the avowed objects of those of the Council who claim to be votaries of all that tends to the amelioration of the lot of the masses. By their works and the resulting rates, we know them. However, if the Council are ultimately given power to supply, it is to be hoped that they will not shelve the wise advice of their Finance Committee to obviate financial difficulty by, while retaining general control, relieving themselves of the working responsibility, in part or in whole.

The Meaning of "At."

One of those curious little points which so frequently give rise to lengthy legal arguments, and which are of interest to a wider circle than the parties to the dispute, was in evidence a few days ago in a case which was heard at the St. Augustine's Petty Sessions, and a report of which will be found in our "Legal Intelligence." The Herne Bay Urban District Council had summoned the local Gas Company for failing to provide a testing-place, for failing to give the Council access to the testing-place required to be provided, and for failing to provide facilities for the proper execution of the provisions of the Gas-Works Clauses Act, 1871. This certainly looks a very much more formidable list of "offences" than it really is; for though there were three separate informations, they all related to the same matter. The Company, under the terms of their Provisional Order, were to cause to be provided at the office of the Council a testing-place and apparatus, according to the provisions of the Gas-Works Clauses Act, 1871; and the dispute, practically, was over the meaning of the word "at." The Company, for their own purposes, fitted up a room with testing apparatus at the works (which are not far from the Council offices); and they suggested that, to save expenses, which, of course, would ultimately fall on the consumers, the Council should use this. At the same time, they offered the Council a separate door and key. But the tests were not to be binding unless made in the presence of the Company's representative. There was also to be a reduction in the charge for certain lamps; and the arrangement was to last for three years. It was when this concession as to price was withdrawn that the Council insisted on what they regarded as their "pound of flesh" —that a testing-place should be provided at their offices. The spot chosen by the Council, however, was in an enclosed yard—they arguing that this would be "at" the offices, as the yard was part of the curtilage of the offices. The Company maintained that "at" meant "in" the offices, and that they were not to be expected to provide a special building for housing the apparatus, but merely an enclosing cabinet, to be placed in a room. Whether "at" means "in," and whether a "place" means a building or a containing cabinet, the Magistrates declared that it was not within their jurisdiction to determine; and thus the most interesting part of the case was left undecided. On the second point, they found that the Company were not guilty of "failing to give access" to what did not exist; while on the third question of whether they had failed to afford facilities for the execution of the provisions of the Gas-Works Clauses Act, the Bench were equally divided. Thus the summons was dismissed.

The Discounts Clause.

Touching upon the editorial note in last week's issue dealing with the questions of stand-by gas supplies and discounts, an interesting letter appears in our "Correspondence" columns from a member of the Parliamentary Bar (Mr. F. N. Keen). In it, he points to the fact that, according to "Model Bills and Clauses," as amended this year, incorporation of the discounts clause can be avoided by promoters of Gas Bills by the simple course of undertaking—by a proviso to clause 13 of the Gas-Works Clauses Act, 1847—that every contract "shall be alike in terms and amount under like circumstances to all consumers." We noticed that, in two or three Acts in the past session, the 10 and 15 per cent. for prompt and large consumptions respectively had not been adhered to; and herein is an explanation, for drawing attention to which we are obliged to Mr. Keen. What we and others are at present concerned about is the restraint that was placed on several gas undertakings in the sessions of 1904 and 1905 in this respect before full consideration was given to the pressing competition these undertakings would have to meet in special branches of their business, and to meet which effectively there would have to be liberty of action. Their hands are tied, and many local authorities supplying electricity would offer resistance to any loosening of the ties, though this attitude benefits at the same time suction and ordinary producer gas-plants. Turning from the discounts question, in our "Miscellaneous News" we give the more recent of the model clauses adopted; and although, in our review of the Acts of the past session, attention was incidently directed to their main lines, it may be useful to readers to have the full text of the clauses.

The Flueless Gas-Stove.

An exceedingly animated discussion—taken part in chiefly by medical men and architects—followed the reading of a paper on gas-stoves, presented by Dr. S. Rideal on Wednesday last to the Royal Sanitary Institute. The author had given a title to his contribution, which suggested that he might be intending to deal in a very general manner with the use of gas for heating purposes; but he addressed himself mainly to the flueless variety of stove. As, however, this particular branch of the subject has always proved a highly debatable one, interest in the proceedings did not suffer on that account. As might be expected, the discussion turned to a large extent on the question of carbonic acid, though more than one of the speakers had a good deal to say about gas-stoves with flues. At the beginning of his paper, Dr. Rideal remarked that the chief objection to allowing the products of combustion to escape into the room had disappeared when burners ensuring the complete combustion of the gas were introduced; and it therefore seemed to be only reasonable to suggest that the time had arrived when the advantages of a flue did not outweigh the enormous disadvantage of loss of heat. He then set forth the theoretical conditions of a perfect condensing gas-stove in a room with no ventilation except what would be caused by the replacing of a certain amount of the oxygen by a lesser quantity of carbonic acid—admitting the

non-existence of either such an ideal flueless stove or an unventilated room as he described; and he next gave the results of experiments on different types of condensing stoves. His conclusions were summed up in the remark that, since his paper was written, the Smoke Abatement Society had reported that, with plenty of ventilation, flueless gas-fires would be suitable for warming rooms and passages; and that, from the considerations he put before the meeting, he was inclined to add that flueless gas-stoves—and especially those of a condensing type—were indicated as an aid to defective ventilation. Meanwhile, in reply to a protest last October from the Society of British Gas Industries, the Exhibition Committee of the Royal Sanitary Institute stated that they had no evidence that would justify them in withdrawing the regulation debarring from their shows any stove in which heat is produced by combustion without a flue being provided for carrying off the products. The wide ground covered by the discussion will be seen from the report of the proceedings which appears on another page in this issue.

Gas Lighting for Railway Premises.

There cannot be very much to be said on the subject of the indoor and outdoor lighting of railway premises by gas that was not included in the paper which Mr. Henry Fowler, of the Midland Railway Company, Derby, presented to last week's meeting of the Institution of Mechanical Engineers. This particular method of lighting was dealt with in an exhaustive manner; but at the same time the author did not confine himself to it—oil, acetylene, carburetted air, and electricity all came in for notice. Gas is admittedly the light with which Mr. Fowler has had most to do; and the large amount of information he gives with respect to it will be of use to many others besides his brother railway lighting engineers. A perusal of the paper leads one irresistibly to the conclusion that, where a supply of gas is available, there must be very few places indeed in which this illuminant cannot be satisfactorily employed. The Midland Company, in common with other railways, have largely gone in for incandescent gas lighting; and, in view of the peculiar conditions prevailing, it is gratifying to learn that Mr. Fowler does not find the mantle consumption high. At the end of last June, his Company had over 48,000 incandescent burners in use in all situations; and the number of mantles used by each burner averages 5·2 per annum. Where large units of light are required, good results are being obtained with the high-pressure system; and the author specially mentioned one installation of which he has charge that is successful from both an illuminating and an economical standpoint, with two-burner lamps placed 56 feet apart, and with mantles 13 feet above the platform. In the full abstract of the paper which we publish to-day, Mr. Fowler's description is given of his lighting of goods yards and sidings, goods sheds, locomotive sheds, workshops, locomotive erecting shops, brass foundry, fitting and paint shops, carriage shops, and iron foundry, Owing to the early part ot the meeting being taken up with the completion of the discussion of a paper which had been read previously, there was not much time at disposal then for the consideration of Mr. Fowler's contribution. The discussion was, however, opened; and after a few remarks had been made by three or four speakers, it was adjourned. Between now and the next meeting of the Institution, the members will have an opportunity of going more fully into the matter; and there should be an interesting debate when the discussion is resumed.

The Kent County Developments.

It has already been announced that an appeal has been lodged against Mr. Justice Joyce's recent decision in the application of shareholders of the Kent County Gas Company for the removal of their names from the register of shareholders, and for the return of the money they subscribed. In view of the step taken in regard to an appeal, we are not at liberty at the moment to comment further on the case; but it may be well to point out that reports appear in our "Legal Intelligence" to-day which show that further shareholders have had no difficulty in getting an affirmative judicial reply to their appeals for relief. The promoters of what Mr. Justice Joyce described as a "swindle" must feel heartily sick over their failure to maintain a position that they had thought so well assured. Justice Kekewich was very emphatic last week in declining to grant them the slightest indulgence. A number of other shareholders are moving for relief; and their petitions will be considered on Thursday, when it is probable there will be a development in the shape of a petition for the winding up of the Company. If the winding up happens, perhaps there will be time for meditation in certain quarters over the question as to the safety that exists in leading "godly, righteous, and sober lives" in connection with company promoting in the gas industry. There are men in the industry who are somewhat jealous of its good name among investors, and who will do their best, and lose no opportunity, to frustrate these circumventive promotions.

The Fate of the Old Workers.

If an argument in support of their case is needed by the advocates of old-age pensions, it may be found in the discussion which took place last week at the meeting of the Devonport Town Council. The lot of the old employees of the late Gas Company, left, as one of the speakers said, to the tender mercies of the Corporation, is unquestionably hard. It is not denied that they have done good and useful service. Some of them have been engaged at the gas-works for forty years. If they had not been good and useful servants, it is improbable that they would have held their positions for anything like this length of time. Had the Gas Company continued their operations, some consideration would, no doubt, have been shown to them in their old age; and they would not have been turned adrift to end their days in the workhouse, as may now be their fate. But "another King has arisen who knew not Joseph." The opinion of the Gas Committee, as voiced by the Chairman, is that these men have little, if any, claim on the Corporation. They have spent and been spent, "not in the service of the ratepayers, but of a private firm;" and so, as they become past work, they are to go out into the world, to become dependent upon charity or the poor law. There is no denying it is a hard fate; and it is not less hard because it is not uncommon. Under any system of old-age pensions, its hardship would be mitigated. It might have been rendered less irksome if the Gas Company had taken their case into consideration when bargaining for the transfer of the works to the Corporation. Under the conditions of sale, provision was made for compensation and fair treatment of some of those holding official positions under the Company. But, as not unfrequently happens, the humbler class of workers was overlooked. It would have been easy at the time to persuade the Corporation to enter into some arrangement as to these men. The task now is more difficult. The Committee are under the necessity of justifying municipal ownership by producing a profit; and in order to do it, they must run the works on commercial lines. We do not know that any fault is to be found with the Committee for taking this view of their responsibilities. It is noteworthy that their action was not seriously challenged by even the Labour members of the Town Council; and no one accused the Committee of behaving harshly to the men, though it was thought they might be more generous. The Committee, in fact, are in a position of some difficulty in this matter. They have to satisfy the ratepayers by conducting the works profitably, and at the same time they must act up to a certain standard as model employers. All the same, the result to the old employees at the works is one of considerable hardship, which might have been mitigated either by forethought on the part of the Gas Company or by the existence of some recognized pension scheme, whether on a municipal or a national basis.

West's Regenerative Retort-Settings.—We have received from West's Gas Improvement Company, Limited, the latest edition of their catalogue of regenerator furnaces, retort settings and fittings, and horizontal and inclined retorts. It is one of a series issued by the Company, and the special branch of construction work illustrated in it is sufficiently extensive to occupy about 70 oblong pages 9½ in. by 11½ in. The contents are divided into seven sections, comprising regenerator furnaces and settings, ironwork and fittings, retort mouthpieces, the "Bournemouth" arch pipe, West's improved tar-tower, combined liquor seal and tar flush-out valves, and automatic relief apparatus for gas-mains. The particulars furnished on these matters are followed by some useful notes on the construction of retort-settings. The illustrations are exceedingly well printed, and the general get-up of the catalogue entitles it to take front rank as a thoroughly artistic production.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 833.)

MARKETS on the Stock Exchange had a rather chequered existence last week. On the opening day, movements were very irregular; the prevailing tendency being flat, in anticipation of high contango rates over the approaching account. Next day, the wind was blowing from the opposite quarter. Almost everything was buoyant and jubilant; and those welcome guests—buyers—were plainly in evidence. This happy change was the result of a belief that New York was now removed from the list of postulants of gold. In spite of its being account week, this fresh activity was well maintained until Thursday, when the settlement engrossed attention; and then a change came over the position. Apprehension as to money tightness again supervened, and things became dull again. The next day was quite as bad; and further withdrawals of gold made bad worse. Consols fell back to where they had been the previous week, and touched 86 1/16; but on Saturday, they were just a shade better. In the Money Market, despite a fairly abundant supply, there was always a rather hard tendency; and a strong demand for the Stock Exchange helped to keep it so. At the close of the week, rates were very firm on further gold withdrawals being reported. In the Gas Market, business was quiet; and it seemed to grow more so as the week went on—the last day being specially slack. There was no very pronounced tendency perceptible; and movements of quotation were slight. Metropolitan debenture stocks—which of late have not been over strong—came out rather better on *ex div.* quotations. In Gaslight and Coke issues, the ordinary was quiet, steady, and unchanged; and for the third week running, the limits of price between which all transactions were marked were 98¼-99. The secured issues were moderately dealt in. The maximum changed hands at 89¼; the preference, at from 108¼ to 109½; and the debenture, at 84½ and 85 *ex div.*—a rise of 1. South Metropolitan was quiet and steady at from 128 to 129; and the debenture was done once at 85⅝. Commercials were hardly noticed; there being only one transaction in the 4 per cent. at 110½, and one in the 3½ per cent. at 108½. The debenture rose a point. In the Suburban and Provincial group, business was on a normal scale. Alliance old marked 20 3/32, Bournemouth "B" 17⅛, Brentford new 202 and 204, Brighton original 231 and 233, ditto ordinary 165 and 166, British 42, and West Ham 103½. The Continental Companies were but little dealt in. Imperial changed hands at from 179½ to 178—a fall of 1 in the quotation; and Union at 125 *ex div.* European was not touched. Among the undertakings of the remoter world, Buenos Ayres debenture was marked at 96½ *cum div.* and 95½ *ex div.*, Primitiva ordinary at from 7½ to 7 11/16, ditto preference at 5 7/16, ditto debenture at 95½, River Plate at from 12¼ to 12⅝, ditto debenture at from 97 to 98, and San Paulo at 13¼.

The closing prices are shown in our Stock and Share List on page 833.

ELECTRIC LIGHTING MEMORANDA.

The Defence of the Bristol Electric Lighting Committee—The Cost of Street Lighting by Electricity—Backwardness of British Electrical Invention, and the Effect on Commerce.

CRITICISM of the Bristol Corporation electric lighting undertaking has had (as former references in the "Memoranda" have shown) a good run lately in the local papers; and the Electric Lighting Committee have been compelled to deal with it in a special report. But it is a very tame effort, and does not tell the ratepayers anything more than they previously knew—excepting perhaps in plainer form the fact that street lighting by electricity is an expensive matter when compared with gas-lighted streets, and that, when the increased cost is considered, the ratepayers have not anything for which to be thankful in having an electricity undertaking under the control of the Corporation. The report is padded by historical matter—more important questions are simply glided over in adept manner. The undertaking, it seems, was responsible in its early years for a charge on the rates amounting to £13,904. Since 1896, however, the receipts, by the aid of the revenue subscribed by the ratepayers through the public lighting, has been sufficient to satisfy the capital charges. There has also been something that has been called a reserve (for renewals) fund; but not an invested one. And at March last the balance only stood at £19,110, while the capital expenditure amounted to £671,616. The revenue last year totalled to £70,664; and the gross profits to £39,879. But even now, since the publication of other reports on depreciation, one local organ is not satisfied that things are quite what they are represented to be by the Committee. However, we give the above figures in order that we shall not be charged with unfairness; because, from our point of view, the most attractive part of the Committee's report deals with the public lighting, and it is to that we wish to devote a little attention.

In this section of the report, generalities are thickly strewn; and the soundness of argument is injured by the nominal values quoted by the Committee. The Committee deny that the cost of lighting the streets by electricity is double the amount, light for light, that would be charged by the Gas Company; but they carefully avoid advancing a shred of evidence in proof of their denial, nor do they touch the question as to whether arc lamps are beyond the need. However, the Committee give what purports to be (they do not enter into details so that the figures can be checked) the actual cost per mile for arc lighting in the city. Where "2000-candle power" lamps are used, the cost is £672 per mile; and where "1000-candle" power lamps are employed, the cost is £435—the average charge over the whole area being £461 14s. per mile. It is humorous to see the Committee quoting these nominal candle powers for the arc lamps in Bristol streets, when their Engineer must know, as well as we do, that these nominal powers are not the effective and really serviceable ones. To show how reasonable their own charge per mile is, the Committee quote the costs in London—"kindly given by the various Borough Councils." Why go to London? Why not show what the cost per mile of incandescent gas lighting is in Bristol, as compared with the electric arc lamps? To us the interesting point about these figures is that they are considerably higher than those that the opponents of street lighting by electricity in London have hitherto quoted. Having been "kindly given" by the Borough Councils themselves, there is no occasion to question the figures; and the blacker aspect they give supplies greater reason for protesting against indulgence in this costly system of lighting streets. Here are the figures: Shoreditch, £749 19s. a mile; Islington, £893; St. Pancras, £236; Hampstead, £492 15s.; Marylebone, £727 16s. 8d.; Fulham, £880; Southwark, £949 13s.; Battersea, (a) £533, (b) £293 6s. 8d. (there is also a rate in aid of the undertaking of £12,115); and Hackney, £390 16s. Will the ratepayers of Bristol please note that, as in the case of their own city, these Borough Councils, who commit the ratepayers to such exorbitant charges for street lighting, and who have, in late years, under the domination of the Progressives, extended the street lighting on these expensive lines, are local authorities who own electric supply works, and who compel the ratepayers to pay much more than is necessary for their street lighting, for the sole purpose of giving business to the Council's electricity undertaking. The contrast of the figures quoted above is the cost per mile of street lighting by incandescent gas-burners. Figures on this head are also given in the report: Lewisham, £72; Deptford, £74; Greenwich, £79; Camberwell, £90; and Lambeth, £91. With reference to the Committee's statement that public arc lighting in London has increased by 644 lamps, the figures they give do not agree with an investigation we made in the early part of 1904—the figures also having been supplied by the officials of the Borough Councils. Then the returns showed 4974 arc lamps in use, as against 5432 now, so that the increase on these figures has only been 458. Against this total of arc lamps, there are 77,000 gas-lamps in use in the streets of London to-day, without counting the lamps supplied by the overlapping suburban gas companies. Where a fair field and no favour is given in London, cheap and efficient incandescent gas lighting holds its own.

A return has been issued respecting the applications to, and proceedings of, the Board of Trade in respect of Provisional Orders and appeals relating to electricity undertakings from the session of 1896 to that of 1905. In the last-named year, only one Provisional Order was applied for by a local authority in respect of the area in the Administrative County of London; but outside London, applications were received from 32 local authorities and 29 companies. All the applications by the local authorities were granted; but the number granted to companies was six less than the applications. Subsequently, one of those granted to a company was transferred to a local authority, and three from local authorities to companies. Compared with 1904, the total applications showed a decline of 13—the figures being in 1904, for local authorities 34, and for companies 40. In 1905, the consent of the local authority was dispensed with in the case of the Brentford Electric Supply Company; but *per contra* Orders were refused to companies on the opposition of the local authorities in the case of Barton-upon-Irwell, Brentford (Metropolitan Electric Supply Company), Macclesfield, Rushden, &c. (Rural), and Southall-Norwood. In the last-named case, an Order was granted to the local authority. During 1905 and up to March last, the Board have not been troubled greatly in respect of appeals regarding works, excepting by the County of London Electric Supply Company, Limited, against conditions imposed by the Camberwell Borough Council and the London County Council. The appeal was allowed in one case; but in half-a-dozen others the decision was postponed, pending consideration of the question of the introduction of general legislation—it being understood that the Company were to proceed with the works in question without prejudice to any decision which may be given on the appeals. The attention of the Board was also engaged during 1905 with three applications regarding change of pressures in London; and in all three cases, the alteration was allowed—in the case of St. Pancras, from 110 to 220 volts; Marylebone, from 120 to 240 volts; and Charing Cross Company, from 100 to 200 volts. A list of changes of pressure relating to the Provinces appears in the return, covering the past ten years. There have been no applications since 1903.

There must be something radically wrong with the British electrical profession and industries. Only a few months ago, Sir William Preece was taking them down a notch or two for letting the Continent have the right to all the credit for the development of electric lamps; and now Dr. C. V. Drysdale has, before the Students' Section of the Institution of Electrical Engineers, been

saying all manner of unpleasant things about the position of the electrical industry at home as compared with abroad. He complains that all the most important electrical inventions and developments of the last few years claim Germany or the United States as the lands of their nativity, and that this country, in electrical engineering, has been slowly but surely yielding its place to these other nations. This is mournful reading for electricians; but Dr. Drysdale does not spare the rod in his attempt to put a little more animation into electrical invention in this country. Modern history is a tale of absolute failure to bring forward anything new here. Even in the manufacture of carbon filament lamps, this country has failed to compete successfully; and Dr. Drysdale doubts whether the proportion of British lamps used at the present time is more than a tenth of the total. On the other hand, great as have been the achievements in Germany and elsewhere in the production of metallic filament lamps, this monitor of the electrical industry is most impressed with the method evolved of obtaining the filaments, which is not saying much for their utility. But why is this country behind all other countries in initiative and inventiveness in various departments of electrical industry? The reply is that in Germany and other Continental countries, Science and Technique are the handmaids of commercial development. The commercial effect is summed up pointedly in two or three sentences in the address. Of twenty manufacturers of electrical plant in this country, one pays a dividend of 10 per cent., one 7½ per cent., one 7 per cent., one 6½ per cent., one 6 per cent., and the remainder 5 per cent. or less. Four or more pay nothing on their ordinary shares, and in two cases the preference shareholders get a reduced dividend, or *nil*. In Germany, out of twelve electrical manufacturing firms, dividends are 18, 13, 12½, 11, and 10 per cent., and only three are under 5 per cent. Furthermore, in most cases in Germany, dividends have been rising recently, while in this country there has been a fall except in a very few cases. It is true that, partially, the fault for this lies in the want of encouragement to Science, and in the restricted application of Science to practical development at home. But it cannot be said, in defence of the specialized engineering profession of this country, that their employers, speaking generally, do anything of a worthy character to facilitate work in the cause of progress. The employers' greatest interest here is to get an immediate return upon their expenditure; and in the long run they suffer. Making further comparisons, it must also be admitted, that our insularity and prejudices, over-competition in the electrical manufacturing industries of this country, and the relations of capital and labour, do not tend to assist in advance. We are glad to see in this latter connection that Dr. Drysdale advocates the assimilation of employers' and employees' interests by some form of co-partnership. He refers to the signal success of the South Metropolitan Gas Company, "under the remarkable management of Sir George Livesey;" and he is certain that it is the only ultimate solution of the labour difficulty. Of course, the electrical industry at home do not like such "straight talks" as that of Dr. Drysdale; but if the Doctor has not put his finger upon the reasons for the backwardness of this country in electrical invention, what is the true explanation?

Gas and Electricity Companies as Investments.—In the last issue of the "JOURNAL," we quoted from the Financial and Commercial Supplement to "The Times," some figures showing the changes which have taken place during the past three years in the value of London Gas and Electric Lighting Companies as investments. The writer of the article from which the figures were taken attributed the fall in the quotations of electrical securities partly to depression caused by the threatened power scheme for the Metropolis. But some figures which have reached us in reference to a Provincial town show a similar change to that pointed out in the article. In November, 1903, the ordinary 5 per cent. stock of the Gas Company was quoted at 104, whereas last month the figure was 113¼. In the same period, the ordinary shares of the Electric Supply Company dropped from 126¼ to 110. There was no fear of a competing power scheme here; so the cause of the rise and fall respectively must be attributed to a change in the views of investors.

Reduced Charge for Incandescent Burner Maintenance at Reading.—Acting upon the advice of their Engineer (Mr. Douglas H. Helps, Assoc.M.Inst.C.E.), the Directors of the Reading Gas Company have lately reduced the charge for the maintenance of incandescent burners from 3s. to 1s. per burner per annum if the consumers contract with the Company for all the burners upon the premises, and to 1s. 6d. if for only a portion of them. On a neatly printed folding card announcing the reduction, the advantages of the incandescent system are set forth, and five very good reasons are given for its adoption; two being that it assists ventilation and is the safest form of light. It is needless to say that mantles and glass chimneys cannot be renewed for the sum named; but the Directors believe the concession they are making is on the right lines, and that it will prove of much greater benefit, so far as the consumption of gas used for lighting is concerned, than a reduction of 1d. per 1000 cubic feet in the price of gas, though we believe it is also their intention to make this. The present maintenance rate is particularly low; and, so far as we are aware, it is not equalled by any other undertaking in this country.

PERSONAL.

Mr. L. GRESHAM BARBER, late of Salford, and at present filling the position of Inspector of Lighting to the Municipality of Colombo, Ceylon, has obtained an appointment with the Oriental Gas Company at Calcutta, and takes up his duties early in the New year.

At a special meeting of the Gas Committee of the Belfast Corporation last Friday, Mr. R. SHARPE, the Assistant-Manager of the gas-works, was appointed Manager, in succession to Mr. James Stelfox (who, as already announced, has retired), at a salary of £700 per annum, with a free house and ground.

From among more than a hundred applicants, Mr. ARNOLD WISEMAN BRANSON, Assistant-Manager of the Hartlepool Gas and Water Company, has been selected for the position of Manager to the Rhymney and Aber Valleys Gas and Water Company, as successor to Mr. A. R. Cawley, whose resignation was announced recently in the "JOURNAL."

Mr. JAMES WIGGLESWORTH, who is succeeding Mr. Thomas Blackney as Secretary of the Perth (Western Australia) Gas Company, is the son of Mr. Edward Wigglesworth, the General Manager of the Company—a gentleman well known by his professional colleagues in England, as it is only a year or two since he paid a visit to the Old Country.

On the occasion of the celebration of his silver wedding, Mr. WALTER PARKER, the Collector of the Ipswich Gas Company, was presented by his colleagues with a handsome silver-plated Queen Anne tea-pot and tray. The presentation was made by Mr. G. A. Mallett; and, in acknowledging the gift, Mr. Parker spoke of the good feeling which had always existed between the members of the staff.

Mr. MILES W. MATTINSON, K.C., has relinquished his directorship of the Welsbach Incandescent Gaslight Company. Shareholders will receive this news with sincere regret, says the "Pall Mall Gazette;" for, since he has served on the Board of the reconstructed Welsbach Company, "Mr. Mattinson has played a very important part in reducing the working costs of the undertaking to something like a reasonable level. However, proprietors of the Welsbach Company are at least entitled to argue that, in deciding to resign his seat on the Board of that concern, instead of any other of his many posts, Mr. Mattinson is actuated by the feeling that the Welsbach Company are now strong enough to get along without his assistance." Mr. W. W. WRIGHT (who was on the Advisory Committee, at the time of the reconstruction) has been appointed to fill the vacancy.

OBITUARY.

We regret to record the death, last Sunday evening, of Mr F. L. RAMSDEN, the Engineer and Manager of the Burton-upon-Trent Gas-Works. Mr. Ramsden had been suffering for more than two years from a distressing disease; and his condition was so serious at the early part of last year, that his colleagues in the Midland Association, at the suggestion of the President (Mr. George Helps, of Nuneaton), passed a vote of condolence with him. Mr. Ramsden was about twenty-five years ago an assistant in the Effingham Street works of the Sheffield United Gas Company; but on the death of Mr. John Mudie, who was Manager at Burton, in July, 1885, he was appointed to succeed him. Mr. Ramsden at once began to prepare plans for a considerable extension of the gas-works; and, with certain modifications, they received the approval of Mr. Corbet Woodall. He was subsequently entrusted with the management of the electric light undertaking of the Corporation; but a few years ago he was relieved of these duties. Although in such ill-health, Mr. Ramsden's desire to further the interests of the undertaking of which he had the control never up to the very last seemed to flag. A scheme for the supply of cheap gas for heating and power purposes was introduced under his supervision; and, by means of attractively printed cards, to which we have directed attention, he encouraged the residents and manufacturers of the town to avail themselves of it, as well as of coke. Only in August last we noticed an improvement he had effected by the adoption of incandescent gas lighting in a portion of the town in which a new public square had been formed. Mr. Ramsden joined the Gas Institute as an associate in 1882, and was transferred to the class of members the following year. On the amalgamation with the Institution, he passed into the new body. He was admitted a member of the Midland Association of Gas Managers at the April meeting at Wolverhampton in 1886. Of late years, Mr. R. S. Ramsden has been associated with his father in the management of the gas-works.

The Council of the British Association for the Advancement of Science have appointed the Presidents of sections for the meeting at Leicester next year. We are pleased to notice that Professor Arthur Smithells, of Leeds, will preside over Section B (Chemistry); and Professor Silvanus Thompson over Section G (Engineering).

THE "LADDITE" MANTLE.

Until recent times, we appeared to have arrived at a stage when the final word had been said in regard to the improvement of incandescent gas mantles, without some radical departure from present methods could be hit upon. But latterly two or three inventors have put in appearance with mantles whose powers of resistance to the wear and tear of active life are said to considerably exceed those of all predecessors. It is characteristic of the Britisher to hear of such things, and to hope there is truth in them, but to entreat a little demonstration before complete acceptance. Most of the real improvements in the making of mantles, such as they have been, since Welsbach perfected the original, have come to us from abroad. But there is now a claim to advance on the part of an Englishman—Mr. John Ladd, of Surbiton; and at the office of the "Laddite" Incandescent Mantle Company, Limited, we have had an opportunity of seeing the mantles in use, and of hearing something about their special properties. Mr. Ladd has been at work endeavouring to improve both the lasting and the light-giving powers of mantles for some considerable time; and now he presents what he believes will be regarded as a successful issue to his labour. There is nothing special about the fabric of the mantle; and thorium and cerium are used in the impregnating solution, but the solution is composed in part of a substance which the inventor has named "Laddite." What "Laddite" is is unknown we suppose to all but Mr. Ladd, and will remain so unless the formula escapes, or some investigator succeeds in robbing the mantle of its secret. The making of the solution is therefore a "secret process." But to "Laddite" is ascribed the power of rendering to the ash of the mantle fabric a certain amount of toughness, and of exerting an influence productive of increased brilliance. There is no doubt whatever about the extreme brilliance of the mantles seen in use on Bray burners of the ordinary type; and as to longevity, various boxed mantles were shown which had been in use—these were high-pressure ones—for over 2000 hours. One mantle had been used on a burner in London, and had proved itself capable of light-giving to upwards of 900 candles. The figure as to gas consumption was not available at the time of the visit. Another mantle had, under other conditions, given a return of 750 candles, burning over 2000 hours. For the ordinary mantles, too, Mr. Ladd claims a life of upward of 2000 hours, under normal circumstances. Testimony from several quarters suggests that the brilliancy of the mantle is enhanced after being in use a short time. Certain it is that those seen alight were rich in their intensity; and the information was imparted regarding the maintenance of illuminating power that, for one test, the loss of light after burning for 1400 hours was only 2 per cent. The used mantles that were placed at disposal for inspection were whole, clean, unfrayed, and did not show the slightest trace of deformity. As to strength again, the mantle is credited with the ability to support seven times its own weight. All classes of mantles, for vertical and inverted burners, are going to be made by the Company; and they are also contemplating the manufacture of special burners. But the "Laddite" mantle is to be their leading speciality. We shall be interested in watching its future.

STANDARD RATES OF WAGES.

The fact that wages for the same classes of work differ in various parts of the country is, of course, common knowledge; but the extent to which this is the case may not be so generally known. One of the many publications of the Labour Department of the Board of Trade, however, is devoted to the standard time rates of wages and hours of labour in the United Kingdom; and the latest issue (a copy of which was recently received from Mr. A. Wilson Fox) contains information with regard to the scale of remuneration in vogue at different places on Oct. 1 last. In addition to indicating to employers where labour is cheap, these returns will prove of service to workmen who are anxious to learn in what places those of their trade are able to command the highest rates of wages—irrespective of any considerations as to possible counteracting influences exercised by variations in the cost of living.

The building trades occupy a considerable portion of the report; and in most cases the figures with regard to these have been agreed to by the Employers' Associations and the Trade Unions concerned, so that they are as reliable as it is possible to make them. Next come the engineering and shipbuilding trades—divided up into the six sections of engineers, sea-going engineers, brass moulders and finishers, ironfounders and patternmakers, boiler makers and iron and steel shipbuilders, and shipwrights, ship joiners, ship plumbers, and ship painters. With regard to the first section—engineers—the statistics are compiled from information furnished by the Amalgamated Society of Engineers, so that there is no reason to question their correctness. In the London district the rate of pay per week for turners, fitters, smiths, and brass finishers, is given at about 39s.; while millwrights earn 41s. 6d., and pattern makers 43s. 6d. In the marine shops at Cardiff, Newport, and Swansea, there is a uniform rate of 41s. per week; but in numerous places the figure is given as being round about 28s. for a week of 54 hours. Marine electrical engineers at Cardiff are put down at 41s. per week; while general electrical engineers vary between 40s. at Montrose, 39s. in London, and 28s. at Keighley.

Among the miscellaneous trades (including police constables, bakers, and agricultural labourers) are to be found gas stokers—the information with regard to which was furnished by the employers and the National Union of Gas Workers and General Labourers. The figures given relate to fifty towns, in addition to the London district; and they include four places in Scotland, but none in Ireland. The eight-hour shift preponderates largely; there being only four instances of twelve-hour ones, and one of nine hours. Between 5s. and 5s. 6d. per shift is the general rate; but in London the figures range from 5s. 9d. to 6s.—5s. 9d. being also paid at Rotherham, and at Birmingham to stokers employed in working charging and drawing machines. In only five cases is the rate under 5s.; and in one of these, merely for night duty. The terms for Sunday work show considerable variation; but though double-time is in all but one case paid in the London district, the general rate named is one-and-a-half times. There are, however, twelve cases in which the men are paid exactly the same for Sunday as for weekday work.

SOCIETY OF ENGINEERS.

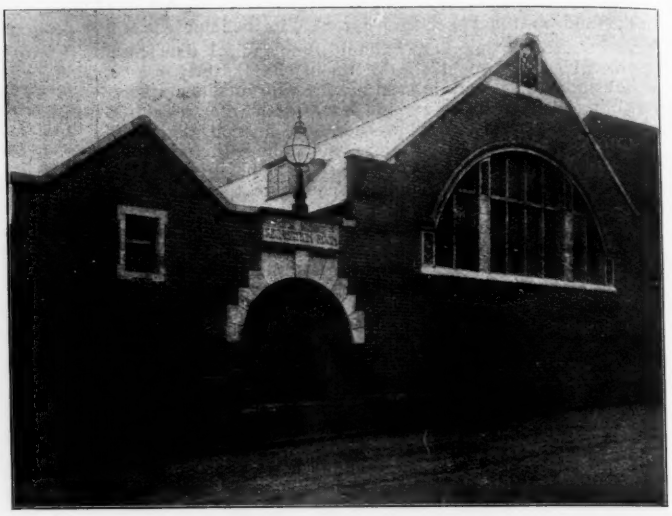
The Fifty-Second Annual General Meeting of the Society was held on Monday last week, at the Offices, No. 17, Victoria Street, Westminster—Mr. Maurice Wilson, Assoc.M.Inst.C.E., the President, in the chair. The following gentlemen were duly elected by ballot, as the Council and officers for the ensuing year: As President, Mr. Richard St. George Moore; as Vice-Presidents, Messrs. J. W. Wilson, W. H. Holttum, and G. A. Goodwin. As Ordinary Members of Council, Messrs. John Aird, Joseph Bernays, F. G. Bloyd, A. G. Drury, George Green, John Kennedy, E. J. Silcock, and D. A. Symons; as Hon. Secretary and Treasurer, Mr. D. Butler Butler; as Hon. Auditor, Mr. Samuel Wood, F.C.A. The President alluded to the death, on the 30th ult., of Sir Edward James Reed, K.C.B., honorary member of the Society in 1877. He also announced the premiums awarded by the Council for papers read during the past session—among them being the Bessemer premium of books to Messrs. W. Pollard Digby and Henry C. H. Shenton, for their joint paper on "The Prevention of the Bacterial Contamination of Streams and Oyster Beds;" and a Society's premium of books to Dr. David Sommerville, for his paper on "The Chemistry and Bacteriology of Potable Waters." The proceedings terminated with a vote of thanks to the President, Council, and officers for the present year, which was duly acknowledged.

The Annual Dinner of the Society was held at the Hotel Cecil on Wednesday evening—Mr. Maurice Wilson (the Retiring President) in the chair. The toast of the evening—"The Society of Engineers"—was proposed by Sir Alexander Kennedy, F.R.S., the President of the Institution of Civil Engineers, who referred to the fact that the Society is third in point of age of the engineering societies, and expressed the hope that it might live and flourish for many years to come. The President, in responding, said the membership of the Society had augmented, and its financial position was thoroughly sound. The attendances at the ordinary meetings had increased 15 per cent., and at the visits 10 or 11 per cent. At one of the meetings during the year they had had an interesting paper by their indefatigable Secretary (Mr. Perry F. Nursey), making his 24th contribution to the Society's Transactions. He concluded by appealing for an increased attendance of members at the meetings and visits. Mr. R. St. George Moore proposed "Kindred Associations," to which Dr. R. T. Glazebrook, F.R.S., the President of the Institution of Electrical Engineers, responded. The toast of "Our Guests," proposed by Mr. J. W. Wilson, was acknowledged by Mr. Maurice Fitzmaurice, C.M.G., the Chief Engineer to the London County Council; and, on the proposition of the President, "The Health of the Secretary," who, he said, had filled every office in the Society, and had for many years worked unceasingly in its interests, was cordially honoured, and Mr. Nursey briefly expressed his thanks. This brought to a close a very enjoyable evening.

North British Association of Gas Managers.—We have received the report of the proceedings at the 45th annual meeting of the Association, held in Edinburgh on the 26th of July, under the presidency of Mr. W. B. M'Lusky, of Perth. The technical matter is followed by the rules of the Association, and the list of office-bearers and members; and appended is the "Statistical Report of the Gas-Supply of Scotland" from July 31, 1905, to Aug. 1, 1906, by the Committee of the Association. The papers are illustrated by plates and prefaced by portraits of the authors; and one of the President and a reproduction of the photograph taken on the occasion of the visit of the members and friends to the Granton Gas-Works form frontispieces. The pamphlet has been produced under the supervision of Mr. R. S. Carlow, the Secretary and Treasurer.

BIRMINGHAM GAS-WORKERS' RECREATION ROOM, DEVON STREET, SALTLEY.

It was announced in the "Journal" for the 4th inst. that on the following Thursday the Lord Mayor was to be asked to formally open a new recreation room which had been erected at Devon Street, Saltley, for the use of the employees at the Saltley, Nechells, and Windsor Street Gas-Works. The ceremony was duly performed; and we are able to give photographic views of the inside and outside of the building, the total cost of which has been about £3500. The Architects were Messrs. Cossins, Peacock, and Bewlay; and the work was carried out by Messrs. Whitehouse and Sons. The chief feature of the building is a large hall 83 feet long and 37 feet wide, which will afford seating accommodation for about 500 persons. There are also cloak-rooms and Committee-rooms, a well-arranged kitchen, and a temperance bar. The inside of the hall has a bright and comfortable appearance, the walls being white, with stained woodwork. A number of pictures, presented by Councillor Jones, add to the effect. Arrangements have been made for the holding of air-gun competitions; and the playing of chess, draughts, billiards, and bagatelle. The large hall will also be used as a reading room.



The New Gas-Works Recreation Room at Birmingham.

Before the opening ceremony, Sir Hallewell Rogers, the Chairman of the Gas Committee, said that for some considerable time the Committee had felt the desirability of building a suitable room in a position easily accessible to the employees of the three large gas-works, where they could spend their leisure during the winter months, under conditions which would ensure their comfort and enjoyment. The object of the Committee was to provide the men with a suitable recreation room at a minimum cost; and it was their earnest desire that the men would avail themselves to the utmost of the facilities afforded, and which they trusted would be for their social and moral good. The City Council, through their representatives, had done their part; it remained for the men to do theirs. He was sure the Council were right in making such provision; and he trusted that, by reason of the pleasant and profitable hours spent there, the lives of the men would be brightened and made more happy. Such facilities, they hoped, would attract the best class of men to their works; for in such an important matter as the manufacture of gas it was necessary to have steady and reliable men.

Interior of the Room, looking East.

On rising to declare the room open, the Lord Mayor (Councillor Sayer) complimented the men upon having a Committee who took an interest not only in their day's work, but in their enjoyment also. This was a splendid building; and the amusement and intellectual enjoyment they would partake of there would no doubt have the effect of improving their workmanship by day. Spending their leisure in the room in rational amusement, they would become better men in their homes. He had pleasure in declaring the room open.

The Lord Mayor having been thanked, a similar vote was accorded to Sir Hallewell Rogers and the members of the Gas Committee for their kindness in providing the building. In his reply, Sir Hallewell Rogers expressed thanks for the help received from Mr. Henry Hack (the Engineer-in-Chief), Mr. G. Hampton Barber (the Secretary of the Gas Department), Mr. W. Chaney (the Works Engineer at Nechells), and Mr. Dingley.

EXTENSIONS AT THE AIRDRIE GAS-WORKS.

In the early months of last year, Mr. David Vass, the Gas Manager to the Corporation of Airdrie, reported to the Town Council that certain alterations, and extensions were necessary in order to put the works into thorough repair. The suggested improvements have been carried out; and last Thursday afternoon the members of the Council and a few friends met at the works for the purpose of formally inaugurating the new plant. As there was a mantle of snow upon the ground and works, the opening ceremony was a brief one.

The Convener of the Gas Committee (Mr. John Orr), addressing the company, said that those of them who had watched the erection of the new gasholder—a mammoth one for a town of the size of Airdrie—must have been impressed with the fact that the Contractors and those who were engaged in the work were men who knew their business. The greatest credit was due to the Engineers and to the Contractors for the expeditious manner in which they had carried their work to a conclusion. He had great pleasure in turning on the gas supply to the holder. He then turned on the gas, and the holder at once began to rise.

Luncheon was served in the Council Chamber—Mr. Orr presiding—at the close of which a toast-list was gone through. Ex-Bailie Donald proposed "The Town of Airdrie." Provost Knox, in responding, said that the starting of the new gasholder meant that the town had so increased in recent years that the demand for light had compelled them to enlarge their works. It was a pleasant thing to be engaged in the duty of providing more light, and he trusted better and cheaper light, for the inhabitants.

In proposing "The Gas Undertaking," ex-Provost Martyn said it was about fifteen years since the question was first raised in the Town Council of acquiring the gas undertaking; but it was not until 1904 that the Council met the Directors of the Company and came to a final understanding with them—one which, in his opinion, was honourable for both sides. Before, however, they entered into any agreement, the Council were determined to have no arbitration in the business. They considered that if they and the Company could not come together as man meeting man, the thing would be off. He thought those who knew anything about arbitrations would agree that they were right in coming to this conclusion. The Town Council of that time felt that if the burgh was to take over the gas undertaking, it must be then or never. The Company were arranging for the purchase of an adjoining piece of ground, and were purposing to enlarge their works to a considerable extent; and if they had been allowed to go on, there would have been no buying the works at all. He thought the Council took the tide at the proper time; and whether or not it would lead on to fortune, he believed that what had been done would tend to the well-being of the community. A very considerable sum, as they would have seen that day, had been laid out in perfecting the works; but, notwithstanding all this expenditure, he was convinced that the Council of to-day would not take a profit of £10,000, and hand the undertaking again over to a private company.

In acknowledging the toast, Mr. Orr said that ever since first it was his privilege, in the early months of 1903, to advocate the purchase of the gas undertaking, he had expressed himself

as a convinced believer in the desirability of having all public services—such as water, gas, electric light, and tramways—under municipal control. The number of gas undertakings in municipal ownership still formed a comparatively small part of the total in the United Kingdom. In Scotland, however, municipal gas supply was on a much larger scale than in either England or Ireland; 85 per cent. of all the gas made in Scotland being produced in municipal works—though they only numbered 50, as against 207 owned by companies, the former being mostly in the large cities and towns. Thanks in a great measure to the inventive genius of Baron von Welsbach, he believed there was still a great future for gas as an illuminant, not to speak of its development for heating and cooking purposes. Last year's make in Scotland was a record one, amounting to nearly 15 billion cubic feet. In their own town of Airdrie, gas was introduced 76 years ago. In the year 1830, a Company was formed in Airdrie, with a capital of £2500. For several years after the formation of the Company, the consumption of gas was only 1 million cubic feet per annum; and the charge to the consumers was 9s. per 1000 cubic feet. After the initial difficulties had been got over, and the price made more reasonable, the consumption of gas gradually increased till, in 1895, the make was 45 millions. Since then, year after year, with one exception, it had gone up steadily; and last year 72 million cubic feet were produced. With such growth and development, it became apparent that considerable alterations and extensions of the works were necessary; so, almost immediately after the acquisition of the undertaking by the Corporation, Mr. Vass reported as to what, in his opinion, was necessary to put the works into thorough repair. With the exception of two of the items, the scheme he laid down had now been completed. The sulphate plant had been in operation about three months, and was proving a valuable asset to the burgh; and that afternoon the gasholder had been put into use. Its total capacity was equal to 1½ days' consumption of gas in midwinter; and it would thus, to a large extent, do away with the need for Sunday labour, at the same time ensuring regularity and equality of pressure, which it had latterly become practically impossible to do with the limited storage room at their command.

Mr. A. Gillespie followed with a few remarks. He said that what they had been engaged in that day had been both interesting and important—interesting because most of them would have been calling to mind the discussions and resolutions which culminated in the purchase of the gas undertaking, and important because they had seen the achievement of their determination, not only to purchase the works, but to render them more fit for the convenience and profit of the community. Though the time was past when it was necessary to defend the idea of a corporation supplying gas, any more than supplying water, it required courage to deal with and settle the question, and still more to carry through the needful improvements and extensions. But it always needed courage to do a wise thing. He was there that day representing the Contractors and Engineers, and in their name he wished to offer to the Chairman, as a *souvenir* of an interesting event in his civic career, a silver loving-cup or rose-bowl, with an inscription. He asked him to accept this gift from them, and to take it with their best wishes.

Mr. Orr said he had no idea that anything of the kind was coming until a few minutes before. If any reward was necessary for services he had tried to give to the burgh, it was more than amply provided by the consummation of the work.

Mr. Inglis proposed "The Engineers," and in doing so paid a high compliment to Messrs. Gillespie and Son; mentioning that, as Mr. A. Gillespie was Manager of works in which Sir William Arrol was once a foreman, they were proud to have him as their Consulting Engineer. Mr. John Gillespie returned thanks, and expressed the indebtedness of the Engineers to the Corporation and the officials for the manner in which throughout they had received their suggestions.

Treasurer Frew gave "The Contractors," which was acknowledged by Messrs. Shanks and Stewart.

DESCRIPTION OF THE NEW WORKS.

The alterations and extensions proposed by Mr. Vass were: The erection of additional coal-sheds and the provision of coke-handling plant; another condenser, the removal of the existing one to a more suitable position, and an additional washer or scrubber; sulphate of ammonia plant; and the construction of a gasholder. Mr. Vass suggested that these alterations and extensions should be carried out, as far as possible, within the two years following his report. This period has not yet expired; but with the exceptions of the coke-handling plant and the extension of the coal-sheds, the scheme is now completed. The sulphate plant, condenser, and washer have been in operation for some months; and, as already mentioned, the gasholder was brought into use last Thursday. The gasholder and tank and sulphate plant were designed by, and constructed under the supervision of, Messrs. A. Gillespie and Son, of Glasgow, with the co-operation of Mr. Vass; and the other portions of the plant have been designed and supervised by Mr. Vass, with the occasional advice of Messrs. Gillespie. The following particulars of the new works have been supplied to us by Mr. Vass.

The gasholder is perhaps larger than would naturally have been added to works of the capacity of those at Airdrie; but there was good reason for making it as large as it is. The configuration of the ground, which had recently been acquired by the Town Council to permit an extension of the gas-works, made it impossible to put up a second gasholder of anything like adequate size as an extension to the one now brought into use. It therefore seemed to everyone the wise course to erect at first as large a holder as the site would admit; keeping in view the necessity of reserving a considerable portion of the ground for purposes connected with the extension of the manufacturing and purifying part of the plant in the future. The tank for the holder is of concrete, and is 120 feet in diameter and 30 feet deep from the top of the rest-stones to the coping. The bores showed the subsoil to be brown and blue clay, hard sandstone, and grey fakes; and the subsequent excavation proved the bores to be very accurate. A seam of coal about a foot thick was found near the lowest point of the excavation. The best of the clay excavated was retained on the site for filling in at the back of the concrete wall; while the remainder of the material was conveyed to a hollow on the west side of the town, which the Town Council were anxious to have filled up. The walls of the tank are strengthened by steel hoops buried in the concrete; and the inner faces of the sides and bottom are rendered with cement to ensure water-tightness. The Contractors for the tank were Messrs. Shanks and M'Ewan, of Glasgow. They began operations early in February of this year, and were ready for the gasholder erectors in August. When the unfavourable weather which prevailed in the month of May is taken into consideration, the time occupied speaks well for the manner in which the work was handled by the Contractors. Wooden framing has been fixed in the tank, for supporting the crown sheeting when the holder is out of action. It consists of a series of curved rafters and purlins, supported by three circles of vertical timbers and a central brick pier. The framing was constructed by Messrs. Thomas Lamb and Stewart, of Glasgow; and the accuracy with which they carried out their work was shown when the gasholder contractors laid their steel sheets on the framing and found they came in without any alteration whatever.

The gasholder is in two lifts, the inner one 115 ft. 9 in. diameter, and the outer one 118 feet diameter; each being 30 feet deep. The capacity of the holder when fully inflated is 620,000 cubic feet. The guide-framing consists of sixteen steel standards and two tiers of girders. The site is unusually exposed, and the framing has been made correspondingly strong. The accuracy of the setting-out of the dimensions of the tank, and the regularity of the distances between the standard piers, have been commented upon by the Contractors for the gasholder, who found that the drawings had been so correctly worked to that they were enabled to make all their girders in each tier to one dimension, and when they erected them no packings or adjustments were necessary. The Contractors for the holder were Messrs. Clayton, Son, and Co., Limited, of Leeds. They began its erection in September, and completed it ready for putting water into the tank before the end of November; the smartness with which the contract was carried out not having in any way detracted from the high quality of the work.

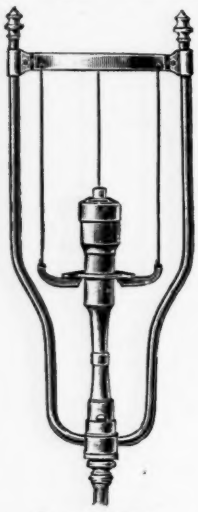
The other portions of the extensions, as already mentioned, included the erection of an additional condenser, and the removal and re-erection of the existing plant. The new condenser was similar in design to the older one, and was of the familiar type, with vertical cast-iron pipes and a supporting chest, with the usual tar and gas connections. The washer, which was added to assist in the work formerly done by a vertical scrubber, was one made by Messrs. W. C. Holmes and Co., of Huddersfield. It is to deal with 500,000 cubic feet of gas in 24 hours, and is complete with steam-engine and bye-pass arrangements. It was during the past summer found necessary to rebuild and extend a considerable portion of the retort-bench, including the removal of five ovens of six retorts each, and the erection of eight ovens of a like number of retorts of larger size. This extension added very greatly to the disorganization which inevitably accompanies the carrying out of important alterations in a works which are in full operation while they are in progress. The introduction of the manufacture of sulphate of ammonia necessitated the provision of ample storage for liquor. An old gasholder, which was thoroughly worn out, was removed, and a portion of the tank was converted into a reservoir for liquor. Partition walls were built across the tank, dividing it into four compartments; and the inlets and outlets for tar and liquor are so arranged that the whole tank acts as a large separator. The tank was roofed over with concrete, arched between steel joists; and the surface is now in use as part of the coke-yard. The sulphate plant is of type similar to many which have been erected in recent years. The still is rectangular, and is combined with a heater of unusually large capacity, to permit of full use being made of the heat from the waste gases arising from the process. The saturator is one of Taylor's solid plate lead type, and is a very substantial and well-finished vessel. The plant is complete with liming arrangements, acid supply tanks, condensers, and purifiers; and there is a store for the finished sulphate in a position convenient to the plant.

It has been considered necessary to provide direct communication between the present works and the ground on which the new holder has been erected. This has been accomplished by cutting through the branch railway which runs alongside the old works at a considerable elevation above the yard, and forming a bridge on the line. The convenience of this access as a passage for the inlet-pipe for the new gasholder has been taken advantage of.

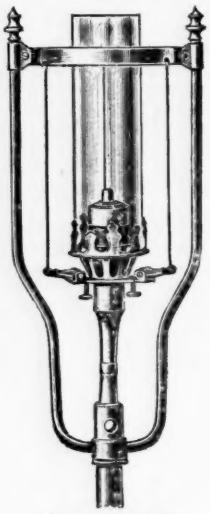
The total cost of all the alterations and extensions has been about £16,000.

THE "B.G." PATENT ANTI-VIBRATOR.

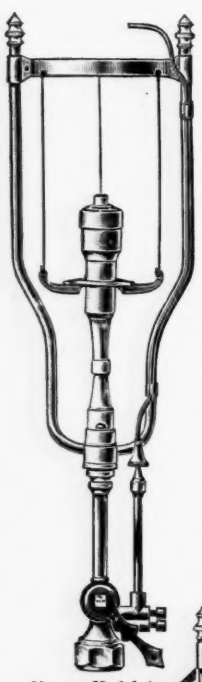
ANOTHER anti-vibrator for use with incandescent gas lighting, which is being put upon the market after a long period of testing,



No. 1.—Model A.



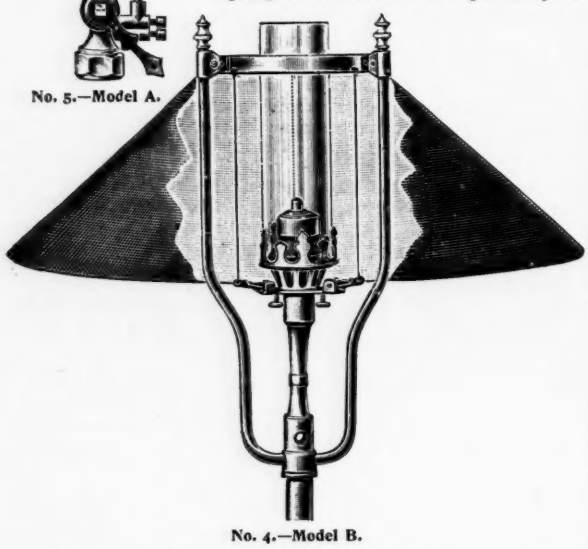
No. 3.—Model B.



No. 5.—Model A.

is the "B.G." This is made in different forms, according to the particular position in which it is intended to be placed and the circumstances under which it is to be used; and it is stated that tests have shown that, with this appliance, it is practically an impossibility to break a mantle by any vibration that can be given to a street-lamp, to a bank or post-office counter—or, in fact, to anything which is particularly liable to shock.

The four accompanying illustrations show various forms of the arrangement: No. 1 is for ordinary street lighting without a chimney; and it can also be had fitted with a gallery for a chimney. No. 3 is for special work where extraordinary vibration is found—such as on bridges. With this model, it is claimed to be practically impossible to break the mantle with vibration. No. 4 is adapted for bank and post-office counters, and places where the ceilings are shaken badly. It can be used either with or without the green shade. No. 5 shows the bye-pass cock—which can, of course, be fixed to any of the patterns. Model A (embracing the outdoor forms) is entirely without springs; while Model B is primarily intended for interior lighting (though it can be used in special cases for street-lamps, where unusual vibration occurs), and is arranged to counteract both horizontal and vertical vibration. With the latter, a chimney must be used to obtain the best results.



No. 4.—Model B.

The invention, it will be noticed, includes a burner, which is of heavy metal, and without any steatite ring, and which is said to burn equally well with or without a chimney—giving uniform illumination to the whole surface of the mantle, and thus producing a maximum of light for the quantity of gas consumed. The illustrations are self-explanatory; but it may be pointed out that the burner is suspended from a brass ring by rods, connected at the bottom to arms which allow the burner and mantle to swing easily. In the forms in which springs are provided, they are fitted to these arms. The gas supply connection is made loose, in order to permit of the free movement of the burner both up and down and sideways. There are no iron parts whatever to corrode or rust; and the whole fitting can be instantly removed when lamp-cleaning is necessary.

It may be mentioned that the sole manufacturer of the appliance is Mr. Henry Bisseker, of Birmingham.

MECHANICALLY COOLING AND CONDENSING GAS.

The current number of "Le Gaz" contains the specification of a patent recently taken out in France by M. Paul Alfred Mallet for a process for mechanically cooling and condensing gas, so that the decomposition of the heavy hydrocarbons is avoided.

Fig. 2.

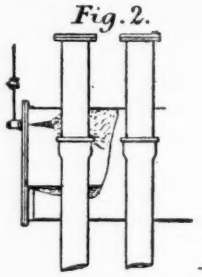


Fig. 1.

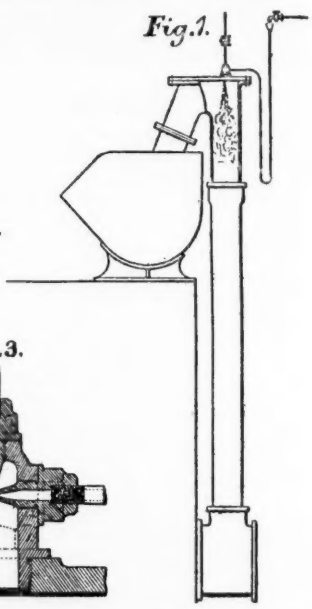
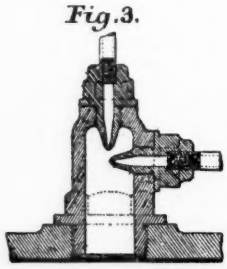


Fig. 3.



In the introductory portion of his specification, the patentee points out that in the carbonization of coal and similar substances the liberated gases are partially condensed as soon as their temperature falls; the result generally being the production of pasty masses which take a more or less solid form by the vaporization of the lighter constituents, and cause obstruction of the pipes. The object of the invention is to prevent this obstruction; and it consists in mixing with the gases, in the ascension-pipes, the bridge-pipes, or the hydraulic main, either clean water or ammoniacal liquor. The operation is performed by driving the liquid at great pressure through a small hole, and allowing it to pass out through a nozzle or orifice, by spraying it in with a slow jet, by Körting helical jets, or in any suitable way. The inventor says the sudden cooling of the gases effected by the injected liquid, which is vaporized, condenses the tarry matters almost entirely in a confined space; and their temperature being lower than that required for the volatilization of the bodies which give them fluidity, they no longer cause obstruction.

The above illustrations show various arrangements for carrying out the process. In fig. 1 is seen the application of the system to ordinary retort-settings; the liquid being injected into the ascension-pipes. Fig. 2 shows how it is applied to the hydraulic main. Fig. 3 is an atomizer. There are, however, other methods of applying the system without affecting the general principle on which it is based.

It was announced recently that the Nobel prize for physics, of the value of £7500, had been awarded to Professor F. J. Thomson, chief of the Cavendish Laboratory at Cambridge, whose researches into the nature of electricity and the kathode rays have attracted so much attention during the past ten years; and that M. Henri Moissan had been selected as the recipient of the prize for chemistry, of a like amount. The name of the latter distinguished scientist will probably be best remembered by our readers in connection with the invention of the electric furnace and the production of carbide of calcium and acetylene gas; but he has also manufactured artificial diamonds.

THE ALLEGED DANGERS OF COAL GAS.

Early last spring, Herr Schäfer, of Dessau, delivered, before one of the Provincial German Associations of Gas Engineers, an address to which he gave the title of "The Alleged Dangers of Coal Gas in the Light of Statistical Facts." The text of the address was afterwards considerably amplified, and has recently appeared as an article in the "Journal für Gasbeleuchtung," whence we have prepared the subjoined account of the author's data and arguments.

Herr Schäfer's aim in giving his address was to enter a protest on behalf of gas engineers against the manner in which all trades and manufacturing processes are controlled in Germany with minute affirmative and prohibitive regulations—a method of procedure, he said, that for years past has caused the technical men of all civilized countries to smile. At the present time, a Bill is being considered by the Prussian Legislature having for its object the supervision of electrical generating stations; and if, or when, this becomes law, gas-works may be the next victims, unless the agitation that is now beginning to spread throughout the Empire in opposition to unnecessary Government interference with trade and industry produces some result. Naturally, in fighting for their own hand at the present juncture, electricians are striving to prove that gas imperils the lives and property of citizens to a far greater extent than electricity; prominent representatives of the latter industry constantly repeating such statements as that electricity is "much less dangerous" than coal gas, that gas takes an "extraordinarily heavy toll of human life," and that the accidents on gas-works are "very frequent." These assertions are freely printed in the newspapers, and meet with general belief; for the speakers appear to forget, the journalists fail to realize, and the public are in no position to see the fallacy underlying the claims put forward. The figures on which these assertions are based have been prepared by collecting the newspaper references to deaths, fires, &c., brought about by gas and by electricity during a certain short period of time (usually in the winter months when gas accidents are relatively most frequent, not in the summer when most electrical accidents occur); and they are published without any correction for the vast numerical superiority of the persons who use coal gas over those who take current. Manifestly, the only justifiable method of comparing the degree of danger inherent to the use of gas and of electricity is to compare the number of accidents that have taken place over a long period of time when those accidents are expressed as a proportion of the number of persons who make use, or of the quantity which is used, of gas and electrical current respectively.

The Consumption of Gas and Current.

In order to show, therefore, how greatly the consumption of gas exceeds that of electricity in Germany, Herr Schäfer has prepared tables and diagrams representing year by year since 1890 the number of connections to the mains of the gas makers and to the cables of the electricity generating stations in many of the principal cities of the Empire. In the first place he deals with Berlin, excluding the surrounding towns or outlying districts, but including the central portion of the capital and the nearer suburbs. The area studied is that supplied with gas by the municipal undertaking and by the Imperial Continental Gas Association; the actual figures being derived from the periodical returns published by the Magistracy and data supplied by the Association. The figures for the electrical connections are obtained from the returns of the "Berliner Elektrizitätswerke," and, more recently, from tables printed in the "Elektro-Technische Zeitschrift." From 1890 to 1901 the electrical figures show the number of consumers; but from 1902 to 1905 they indicate both the number of consumers and the number of meters. The gas figures record the number of meters. Hence up to 1901, when differential rates for gas were abolished, the figures are unfair to electricity, because the numbers of gas-meters are compared with the numbers of electricity consumers, and both classes often used two or more meters each. But the errors thus introduced are too small to affect the general result.

The Berlin figures show that, at the close of the period investigated—*i.e.*, March or June, 1905—the number of electricity meters in use was 21,465, and the number of gas-meters 235,260—say, eleven times as many. The total number of new electricity meters installed since 1890 was about 20,000; the corresponding number of gas-meters over 163,000—more than eight times as many. In the last year, 1904-5, 3609 new electricity meters were installed, and 17,538 gas-meters were fitted up—nearly five times as many. The excess of gas-meters over electricity meters in 1890 was approximately 71,000; by 1905 it had risen to 215,000—*i.e.*, had nearly trebled. Thus it appears that in Berlin the use of coal gas is not merely continuing to increase since the advent of competition, but that the consumers of gas are growing in number much more rapidly than the consumers of electricity, and that even to-day there are far fewer consumers of electricity than there were consumers of gas at the time when electricity was first distributed in Berlin.

Another method of comparing the consumption of gas with that of current is to consider the amount of energy distributed by the respective manufacturing concerns. In order to do this, the energy must be recalculated into some comparable form, such as heat units; and to avoid all possibility of cavil, the following conversion factors may be employed—viz., 1 cubic foot of gas is equal to 147 large Calories, or 584 B.Th.U., and 1 K.W.-hour or B.Th.U. is equal to 860 large Calories, or 3410 B.Th.U. Considered on this basis, the amount of energy distributed in the form of electricity in the same districts of Berlin as have already been dealt with, has risen from 2411 million Calories in 1890 to 95,954 million Calories in 1904; whereas the energy distributed in the form of gas has risen from 660,400 million Calories in 1890 to 1,297,400 million Calories in 1904. In other words, the amount of energy distributed as gas is more than 13 times as great as that sold in the form of electricity; and, as was found to be the case when counting meters, the excess of energy supplied as gas over that supplied as current has increased from 1890 to the present time—has indeed almost doubled. Moreover, it should be clearly remembered in making this comparison on the energy basis, that much of the electrical current generated has been consumed in the propulsion of tramcars; and this is a demand which finds no parallel in the gas industry. In 1904, the amount of energy taken by the cars in Berlin was about 47 million K.W.-hours—*i.e.*, was over two-fifths of the total supplied.

What has been said above about the overwhelming consumption of gas in comparison with that of electricity in Berlin, is also true of most other towns and cities in the German Empire. Taking 30 important towns selected at random outside Berlin (the names being given in full by Herr Schäfer in his original communication), the figures for the year ending with March, 1905, show that the total number of electrical connections or meters reached 72,000; while the total number of gas connections or meters in the same places reached 730,000—*i.e.*, was over ten times as many. In comparison with gas, electricity was most largely employed in Munich, where, at the date mentioned, there were 3·7 times as many gas-meters in use as electricity meters. In Danzig and Wiesbaden, there were also fewer than five gas-meters at work for every single electricity meter; whereas at the opposite end of the scale, where electricity is comparatively least used—viz., at Zwickau, Karlsruhe, and the portion of Leipzig served by the municipal gas undertaking—the proportion of gas-meters to electricity-meters exceeded 20 to 1. The figures relating to these provincial German towns also prove that in most places the number of new gas-meters installed every year equal or exceed the total number of electricity meters in use—*i.e.*, that in a single year the gas undertakings have obtained as many new customers as the electricity undertakings have attracted in ten, fifteen, or more years. Adding together the returns from all the 30 towns, the electricians succeeded in obtaining 10,701 new consumers during the year ending with March, 1905, whereas the gas makers obtained 87,896.

Since the different electricity undertakings were started, they have obtained 71,911 consumers, while the gas makers have obtained 425,389 since gas was first supplied; and, moreover, the gas makers have obtained 240,068 new consumers since the date when competition with electricity commenced. Magdeburg is unique, inasmuch as the electricians obtained more consumers during the last year covered by the returns than did the gas makers (830 to 258); and Plauen is the only town where the electricians have at last acquired more consumers than the gas-works possessed before the electrical generating station was opened. Even at Munich the electricity works has only 9344 consumers, as against the 11,682 possessed by the gas-works when electrical current was first distributed there. In no case has the numerical excess of gas-meters over electricity-meters decreased from what it was when current began to be generated—the excess has indeed grown. In Munich, the excess has increased from 11,682 in 1893 to 25,195 in 1905; in Plauen, from 2286 to 13,264; in all the 30 towns together, it has grown from 250,000 in 1893 to 660,000 in 1905. Similar conditions prevail in many other large towns and cities, and in a great number of smaller places in Germany; and it is specially noticeable that in those very towns where the first electricity generating stations were built, the use of gas is still growing out of all proportion to that of electrical current.

Yet another method of considering the relative developments of gas and electrical industries in Germany is to compare the number of gas-meters that are officially stamped each year with the number of new electricity meters brought into use, according to the periodical returns published by the "Elektro-Technische Zeitschrift." Strictly comparable figures could only be given if

Year.	Gas-Meters.	Electricity-Meters.
1896	144,885	..
1897	158,107	..
1898	182,975	..
1899	212,462	58,557
1900	240,839	68,138
1901	231,498	39,129
1902	246,361	37,934
1903	278,116	43,608
1904	333,766	22,356
Totals	2,029,009	269,722

electricity meters had to be stamped officially like gas-meters, which is not yet the case. In the annexed table, perhaps 10 per cent. should be taken off the gas-meter figures to allow for old meters that have been repaired and stamped afresh. The small

diminution in the number of gas-meters for the year 1901 is due to the introduction of uniform gas prices at Berlin, Schöneberg, and elsewhere about that date. The number of electricity meters given against the year 1899 is supposed to represent the total number of such meters in use at the time stated; although since the work of collecting the figures had but recently been undertaken by the electrical journal, the result is admittedly too low. Subsequent figures should indicate annual increases in number; that for 1904 being also incomplete owing to the omission of returns from a few unimportant electrical undertakings. These errors, however, are by no means sufficiently large to affect the results seriously.

No one who thoroughly understands the circumstances of the case can believe that the relatively more rapid progress that the gas industry has made in the past, in its competition with electricity, will be stopped or even checked by the new metallic filament lamps which the electricians are now introducing. So far as Germany itself is concerned, the consumption of gas is indeed considerably less than that which obtains in other countries where electricity is sold. For example, in very few German cities does the annual consumption of gas per head of the population exceed 3500 cubic feet. In the large towns it is generally between 2500 and 3000; in the medium-sized towns, between 1750 and 2500 cubic feet. In England, France, and the United States the consumption of gas has for a long time reached 7000 to 10,000 cubic feet per head per annum—was actually 14,000 cubic feet in Newcastle-on-Tyne in 1904. The comparative cheapness of gas in England has nothing to do with the matter; for though the consumption in Berlin during 1904 was only 4400 cubic feet per head, at 3s. 5d. per 1000 cubic feet, while that of London was 8000 cubic feet, at "2s. to 2s. 6d." per 1000 feet, the consumption in Paris was 4500 cubic feet, in spite of the selling price being 6s. 8d. Moreover, the use of slot-meters in Germany is still comparatively in its infancy. At the end of March, 1906, the Municipal Gas-Works at Berlin had only 27,063 prepayment gas-meters in use over and above its 190,804 ordinary meters. At the end of 1904, the three leading London Gas Companies were supplying gas through 396,009 slot-meters as well as 383,441 ordinary meters. As regards the future, too, it should be remembered that great advances are being made in the warming of flats and whole houses by means of automatic gas-fired apparatus—a most important field in which the electricians are economically unable to compete. Since the year 1900, again, the number of newly erected public electricity supplies has steadily diminished from 140 to 40 per annum; whereas the number of new gas undertakings has remained constantly between 70 and 80, rising finally to 87. A feature of recent years has been the supply of several towns or villages with gas from one new works, or from the works of the nearest large town, and the long-distance transmission of gas at high pressure.

It may be urged that the data employed to estimate the comparative amount of danger introduced into city life by the use of gas and of electricity respectively should not be those relating to the number of consumers, but such as represent the number of "points." The view is erroneous, because the number of buildings or houses into which gas or electricity is led affects the risks involved more than the number of connections with the service in each house; and, were it not so, material is lacking for a fair comparison of the "points." The electricians know the actual number of lamps they supply with current; gas-makers only know the total nominal capacity of their consumers' meters, and of course "5-light" meters, for instance, often supply from 10 to 12 lights. A gas "light," in meter-makers' phraseology, is equal to the consumption of 780 Calories of energy per hour; a normal electric lamp, to only 43 Calories. A gas-engine is equivalent to only 5 to 8 "lights" per nominal horse power; an electrical motor, to 18 normal lamps. Gas lights are used on an average for 500, 600, or more hours per annum; electric lights for only 300 or 400 hours. Nevertheless, although the numbers of gas and electrical "points" are incomparable, the following figures may be quoted. According to the returns of the "Elektro-Technische Zeitschrift" for 1906, the electricity generating stations of Germany were supplying a recalculated number of just over 13,000,000 normal lamps, almost half being glow lamps; while at the end of 1899, the gas undertakings of Germany were supplying at least 16,000,000 normal lights. As 1·3 million meters have been installed since then, this number must have been increased by 13,000,000 nominal, or 20,000,000 actual new lights—street lantern burners being omitted. As before, statistics tend to show that the new lights supplied with gas every year exceed in number the total lights supplied with current.

A further objection may be brought against the foregoing statistics, on the ground that the electrical figures cover only the operations of the public generating stations, whereas the private electrical plants running in numerous factories, hospitals, hotels, ships, and the like, ought to be allowed for. It is to be regretted that proper statistics on the subject of private electrical plants no longer exist in Germany; but an attempt to allow for the current they generate has been made in the following manner. A dozen years ago, the amount of current generated privately was much larger than that sold by the public electricity works; but every indication shows that this state of affairs no longer prevails. In fact, the only city known to the author where the public electricity works supplies less current than the combined private installations is Leipzig, where the quantities in 1904 were 76,000 and 87,000 kilowatts respectively. Now, according to the official figures published by the Royal Statistical Office of Prussia ("Statistischer Landesamt in Berlin"), covering the amount of steam power used in the generation of current, there were within that kingdom on April 1, 1905, 5679 steam plants with a total capacity of 788,981-horse power employed wholly or partially in driving dynamos; and according to the tables of the "Elektro-Technische Zeitschrift," there were in Prussia, on the same date, about 400 public electricity works generating 390,000 horse power. It is known that four-fifths of the current generated is obtained from steam power, the ratio being presumably the same in public and private cases. Hence it appears that in Prussia half of the total current generated comes from the public supply stations, and half is produced by the private installations; and there is no reason to assume that a different proportion obtains in other parts of the German Empire. Hence it may be calculated that there are now 26 million electric lamps of normal size running in Germany; 13 millions being supplied with public, and 13 millions with private current.

It is, however, necessary to observe that numerous private installations for coal-gas manufacture exist, many of which make several million cubic feet per annum. Besides these, there are thousands of air-gas plants, supplying as many as 1500 lights each, some 28,000 acetylene installations, countless oil-gas plants, water-gas generators, and pressure or suction power gas plants. According to one of the leading German firms of builders of gas-engines, some 26,000 suction gas plants, developing over 350,000 horse power, are now at work; and according to Reinhardt, there were, at the beginning of 1906, about 400 blast-furnace and coke-oven gas-engines running, generating altogether some 415,000 horse power. The latest electrical returns represent the total capacity of all the motors supplied with current by the public electricity stations at only 310,428 horse power. All these private gas installations have to be kept in mind in considering the question of danger, because fire insurance officials do not differentiate between different kinds of "gas."

Summing up what has been stated above, it may be said that: (1) Gas is much more widely used in Germany than electricity. According to a conservative estimate, its individual places of consumption (houses, flats, ships, &c.) are at least eight times as numerous. (2) Much more energy is distributed in the form of gas than in the form of electrical current—according to a conservative estimate, at least ten times as much. (3) The number of individual consumers, and the amount consumed (calculated in terms of energy) are both growing much more rapidly in the case of gas than in the case of electricity.

The Comparative Dangers of Gas and Electricity.

I.—*Danger to Property.*—In considering the relative degree to which property is endangered by the use of gas and electricity respectively, the attitude of fire insurance officials may be studied first; for the offices assess their premiums by the light of actual experience, not adventitiously. Insurance offices accept at normal premiums both buildings and their contents in which illuminating or fuel gas is consumed; and they make good all damage done whether by fire or by explosion brought about by the gas. In the early days of electric glow lamps (1883), a suggestion was made that the offices might well accept lower premiums for houses lighted electrically, and it was even announced that one office was considering the matter favourably. Up to the present time, however, no such reduction has been made by any German office. In 1901, the German Continental Gas Company inquired of one of the leading associated fire insurance firms whether there was any truth in a current rumour that the rate for electrically lighted premises might be reduced to less than that demanded for gas risks. The reply was made that in no circumstances would such a reduction be granted—that, indeed, it was in contemplation to demand a higher rate, unless the electrical installation were constructed and maintained in such fashion as to fulfil the very minute and lengthy rules drawn up in 1893 by the associated fire insurance offices. It should be recollected that electricity is seldom substituted for gas in a building, it is employed as an addition; and therefore its use constitutes an extra fire risk, not a different one. Electric light may be adopted in the reception rooms of houses and hotels, &c.; but gas is still employed (or left so that it may be employed) to give light in other apartments, and is required to yield heat in many of the apartments. As previously mentioned in the "Journal,"* of 1473 houses in Wilmersdorf (a suburb of Berlin) repaired during 1905, some 611 were fitted with electrical installations, whereas only 18 were not provided with gas connections.

As is well known, the leading houses in Germany that undertake fire insurance work together in two large Associations—one consisting of 18 "private" insurance companies, and the other composed of 36 "public" insurance societies. Up to 1900 or 1901 (but unfortunately not later), both Associations published annual statistics, in which the fires and explosions that took place on insured property were classified according to their causes. Gas accidents were classified into such as were followed, and such as were not followed, by fire; the word "gas," it should be understood, meaning acetylene, oil gas, producer gas, &c., as well as coal gas made both in private and in public works, and including also the vapour burnt in brazing lamps. Each class of accident

* See Vol. XCIII., p. 349.

was further subdivided according as the cause was definitely known, or strongly suspected, to be that stated. Taking the statistics for the years 1899 and 1900, issued by the Association of Private Fire Insurance Companies, it appears that both years the numbers of fires known to have been caused by electricity and by explosions of alcohol were larger than the number of gas explosions followed by fire; that the number of fires following gas explosions was smaller than the number of fires brought about by electrical defects; and that the total number of fires caused by gas and by electricity was very small in proportion to those due to other common accidents. The actual number of instances in which damage by fire was proved to have been due to the stated cause during each of the years mentioned is given in the annexed table:—

	1899.	1900.
Children under 12 playing with matches . . .	1125 ..	963
Explosions of mineral oil	1589 ..	1627
Defects in electrical installations	204 ..	226
Explosions of spirit (alcohol)	207 ..	207
Explosions of illuminating and fuel gas. . . .	158 ..	199

As to the period since 1900, all that can be ascertained from the proceedings of the private insurance companies is that the ascertained number of electrically caused fires was 265 in 1901, 238 in 1902, 248 in 1903, and 278 in 1904; and that the accidents due to the use of incandescent alcohol, which German Government officials are making such heroic attempts to popularize, rose from 96 in 1903 to 208 in 1904.

The following table reproduces certain items from the statistics issued by Public Insurance Societies, the figures covering only fires known to have been brought about in the manner stated:—

	1897.	1898.	1899.	1900.	1901.
Total fires from all causes .	16,950	17,133	18,947	18,316	19,941
Children playing with matches	967	1,012	1,128	1,080	959
Explosions of mineral oil. .	367	362	414	354	415
Explosions of illuminating and fuel gas	67	68	65	57	87
Defects in electrical installations	22	25	51	42	73

Over the whole period, 5·64 per cent. of the total fires were caused by children playing with matches, 2·09 per cent. by the explosion of oil lamps, 0·38 per cent. by gas explosions, and 0·23 per cent. by electrical defects. Assuredly it may be said that if electrical installations require official supervision, so also do paraffin lamps; and so, in a far higher degree, do the children who persist in playing with matches!

The foregoing tables demonstrate that gas can only be said to be equally dangerous with electricity when the comparison is made absolutely—*i.e.*, with the aid of the figures presented. When, however, the figures are regarded in the light of what was stated in the first part of the present article, as to the larger number of consumers and the larger quantity of energy distributed as gas, it becomes manifest that gas is by far the less dangerous of the two. The same thing is shown very clearly in the accompanying diagram prepared from the reports of the Berlin Fire Brigade, in which the vertically-shaded columns represent the number of fires

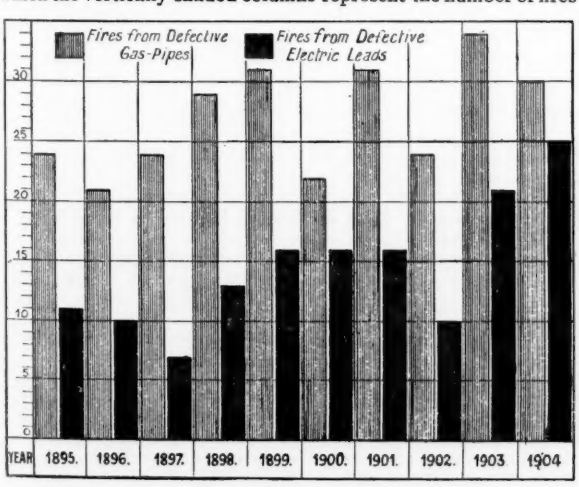


Fig. 1.

caused by "defective gas-pipes," and the solid black columns the number of fires caused by "defective electrical leads." Considering that the number of gas consumers was more than twice as many in 1905 as in 1895, it will be seen that the number of fires brought about by gas has relatively diminished. In the last year covered by the diagram, one fire occurred for every 900 electricity consumers, but only one fire per 8000 gas consumers.

The reports of the Berlin Fire Brigade also show that in the five years 1900-01 to 1904-05 nine fires occurred in electricity generating stations, and only one in a gas-works; that 66 fires took place within the same period in Berlin theatres, 21 of which were caused by short circuits or other electrical defects; and that one or more fires were started electrically in almost every Berlin theatre. The official returns collected by the "Statistischer Landesamt" in Berlin show that during the years 1899-1903 the number of gas explosions (presumably with and without subsequent fires, and including every variety of gas) in the Kingdom of Prussia was 1200—property being thereby destroyed to the value of approximately £45,465; that the number of fires known to have been caused by electricity was 478, the value of the property destroyed being £117,882; and that a further number of 162 fires were probably due to electrical causes, in which the value of the property destroyed was £258,036.

II. *Danger to Life.*—During the five years 1901-05, the average maximum number of men employed in the gas-works at Dessau was 127·4, of whom 9·2—*i.e.*, 1 out of 14—met with some injury each year. The average maximum number of men employed at the electricity station was 31·2, of whom 3·4—*i.e.*, 1 out of 9—were annually injured. At Dresden, during the six years 1900-05, 1 out of 13·2 men at the gas-works was injured on an average each year; and 1 out of 11·6 men engaged at the electricity works. It must be understood, however, that in both cases the majority of the "injuries" had nothing whatever to do with the gas or with the electricity—being simply such accidents as are inevitable in a factory. Only one man of the 46 injured at the Dessau Gas-Works was injured by gas; only one man of the 17 injured at the Dessau Electricity Works was injured by the current. The German Continental Gas Company, who own 18 gas-works, and employ some 1000 men in Germany, had 331 accidents during the last five years; but of these only 9 (*i.e.*, 2·7 per cent.) were actual gas accidents, most of the other cases being falls from ladders, &c., or injuries caused by falling objects. Only one of the nine true gas accidents had a fatal termination—a man being suffocated by an escape of gas at the Potsdam works.

It is greatly to be deplored that no official material yet exists in Germany for the preparation of a table showing the total number of deaths due to gas and to electricity respectively. In the following diagram, however, an attempt has been made to incorporate

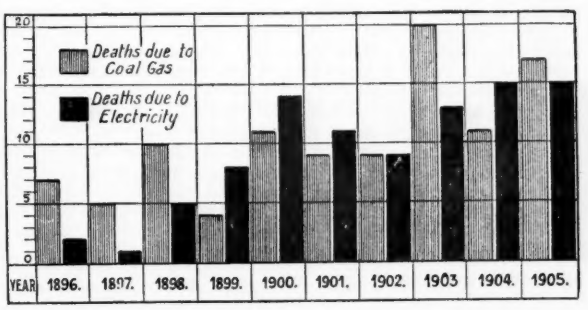


Fig. 2.

all the information which it has been possible to collect on this subject during the past thirteen years. In it, the shaded columns represent the deaths brought about by gas, the black columns the deaths due to electricity throughout the German Empire. The totals for the earlier years covered by the diagram are probably not quite complete; but for the past six years they are presumably fairly trustworthy. All cases known to be deliberate murders or suicides with gas have been omitted, and deaths caused by gases other than "coal gas" or "illuminating gas" have also been omitted. The utmost care has been taken to exclude cases of suffocation or poisoning due to the escape of carbon monoxide from domestic and similar heating apparatus. When possible, newspaper accounts of the various accidents have been verified or the reverse by communication with the local police or other authorities. During the last ten years of the diagram, 103 persons were killed in Germany by gas and 93 by electricity. At least 53 people were killed in Germany by explosions of alcohol, and 202 persons by explosions of paraffin lamps during 1905.

Having thus conclusively shown, by official or semi-official figures, that gas has done and is doing less harm to the lives, health, and property of German citizens than electricity (when due allowance is made for the larger number of persons who consume gas), and that in many respects even when all such correction of the absolute figures is omitted, gas is no more dangerous than electrical current, Herr Schäfer devotes the concluding portion of his article to a castigation of the proposal that gas installations should be subjected to official inspection in Germany. He points out that newspaper reports of gas accidents might well be stereotyped; that they are caused by seeking for a leak with a naked light, by the foolish practice of turning off the main cock on a domestic service-pipe at night when one or more brackets or pendant lights are still burning, or by the escape of gas into a house from a fractured street-main. No appreciable number of accidents so produced could be prevented by official inspection or supervision. With here and there a solitary exception, gas explosions are not brought about by defective installations or by the deterioration of fittings in course of time; they are due to stupidity, to drunkenness, to disobedience, and to forgetfulness of elementary rules that have been preached a thousand times. And these are characteristics of mankind which cannot be exorcised by the strictest inspectors or officials.

FLUELESS GAS-STOVES—AND OTHERS.

At a Meeting of the Royal Sanitary Institute, at the Parkes Museum, Margaret Street, W., last Wednesday, Dr. S. Rideal read a paper which was entitled "The Advantages and Disadvantages of Heating Buildings by Gas-Stoves of Various Types," but which dealt almost entirely with flueless stoves. In the very long discussion which followed, however, many of the speakers did not confine themselves solely to this type of stove, but dealt with the question generally—largely from the standpoint of the recent report of tests carried out for the Coal Smoke Abatement Society (which was noticed in the "Journal" for Nov. 20, pp. 539-41). The meeting was presided over by Colonel J. Lane Notter, M.D., the Chairman of the Council of the Institute. We give below an abstract of the paper, together with a summary of the subsequent discussion.

The author, after remarking that his treatment of the subject would be confined to the hygienic aspect, said there were two types of stoves to consider—those in which the products of combustion were admitted into the room, and those in which they were withdrawn by means of a flue. It was evident that stoves of the latter type had many features in common with stoves burning other forms of fuel in which the products were withdrawn by means of a chimney or flue; and, moreover, that the heating of buildings in this way depended entirely upon the radiant heat and the conduction through the walls and chimney-piece, and that the convection heat was lost. This was the chief disadvantage of all such forms of heating, as only a fraction of the total heat was utilized. Even in gas-stoves of the very earliest type, sulphuretted hydrogen was never found, and only carbon monoxide in minute quantities, while the amount of soot or smoke produced was insignificant. Therefore the chief objections to allowing the products to escape into the room had disappeared when burners insuring complete combustion of the gas were introduced; and it seemed reasonable to suggest that the time had arrived when the advantages of a flue did not outweigh the enormous disadvantage of loss of heat.

Since the report of the "Lancet" Special Commission in 1893, which drew attention to the advantages of gaseous fuel for smoke prevention, the makers had put on the market flueless gas-stoves of various types, which were now in common use, and which had been criticized severely by many sanitary reformers as causing injury to health. The Royal Sanitary Institute had had the subject under consideration for some years; and at the Liverpool Exhibition in 1904 a general regulation was included "that no stove in which heat is produced by combustion will be admitted without a flue being provided for carrying out the products of combustion." The following year, before the Smoke Abatement Exhibition, the Committee were urged to suspend this regulation; but after carefully considering the matter, they decided not to do so. However, the Council, in January of this year, had before them the question of appointing a Committee to report upon flueless stoves; and they recommended that the author should be asked to report upon the sanitary aspects of some of the principal types of flueless gas-stoves now in the market—"taking more specially into account the amount and quality of the products of combustion that escape into the room or dwelling." Accordingly he made these trials in May. Last October, the Exhibition Committee received a protest from the Society of British Gas Industries against the regulation; but it was decided to reply to the Society that the Committee had no evidence that would justify them in withdrawing it.

He then turned his attention to considering what the products of combustion of a gas-stove (with and without condensation) were. Sulphuretted hydrogen had never been among them, and from improvements in burners carbon monoxide and smoke were no longer to be feared; while in his recent inquiry on behalf of the Council, he had satisfied himself that acetylene, another poisonous gas which was likely to be found, was also not produced in stoves of the flueless type. The products, therefore, consisted of carbonic acid, aqueous vapour, and sulphur acids. Roughly speaking, 5 cubic feet of coal gas produced about 2½ cubic feet of carbonic acid and 6½ cubic feet of aqueous vapour, and consumed about 5½ cubic feet of oxygen. The quantity of sulphur formerly permitted in this quantity of gas was equal to 1 grain; but now practically in all towns no sulphur limit obtained, and one expected to find from this quantity of coal gas 2 to 3 grains of sulphur oxidized to sulphurous or sulphuric acid.

It was evident that the water was the largest product; and if it remained in the gaseous condition, a great amount of heat was conveyed by it so as to warm the cool walls. A condensing stove liquefying the whole of the water would, on the other hand, prevent the increase of the moisture of the air in the room which was desirable with the rise in temperature, and would also condense all the sulphur acids, together with a small quantity of the carbonic acid, so that in a perfect condensing stove the only product introduced into the air was carbonic acid, equal to half the volume of the gas burnt. Under these ideal conditions there was an actual reduction of pressure in the atmosphere in the room, owing to the fact that the condensed water occupied practically no volume as compared to the atmospheric oxygen required to produce it. Thus with a stove consuming 10 cubic feet of gas per hour, and using (say) 11 feet of oxygen derived from 55 feet of air, after one hour's burning the 11 feet of oxygen would be replaced by 5 feet of carbonic acid, giving a contraction equal to about 6 cubic feet in the total room space, which must be filled by an influx of a fresh supply of outside air bearing its proper proportion of oxygen. This change would go on from hour to hour. Assuming there was no ventilation other than that produced in this way, and that all the heat was radiated or conveyed to the walls, the composition of the air in the room would approximately be as follows, taking a capacity of 4000 cubic feet:—

—	Nitrogen.		Oxygen.		Carbonic Acid.	
	Cubic Feet.	Per Cent.	Cubic Feet.	Per Cent.	Cubic Feet.	Vols. per 10,000.
When lighted. . .	3198	79·9	800	20·0	2	5·0
After 1 hour . . .	3204	80·1	789	19·7	7	17·5
,, 2 hours . . .	3210	80 2	778	19·5	12	30·0
,, 5 ,, ...	3228	80·7	745	18 6	27	67·5
,, 6 ,, ...	3234	80·8	734	18 4	32	80·0

If, on the other hand, the heat were all utilized in warming the air of the room, the 4000 feet of air would be raised 9° Fahr. for every cubic foot of gas burnt, with a corresponding increase in volume.

It would, said the author, be seen that the actual oxygen reductions were very small—roughly equal to twice the volume of carbonic acid produced; so that if the room gained 25 cubic feet of carbonic acid after five hours in the 4000 cubic feet of space, equal to 0·625 per cent., the quantity of oxygen in the room will have diminished from 800 to 745 volumes, or only 1·4 per cent., while the balance was made up by a slight increase of nitrogen. It was evident, therefore, that, under such theoretical conditions, the composition of the air was only slightly modified by the combustion of the gas in a flueless manner; and it was doubtful whether such variation in the quality of the air had any material influence upon health. The only readily measured change was the increase in carbonic acid; and there was no evidence that carbonic acid *per se*, in these quantities, was injurious to health. Then, again, it had to be remembered that while there was no such ideal flueless stove as he had described, it was equally impossible to find a room so devoid of ventilation as to allow the accumulation of carbonic acid to proceed at the rate indicated. An ordinary closed room was sufficiently permeable to allow the air to be naturally changed every two or three hours.

The author gave a table showing the condensations in some different types of condensing stoves. One cubic foot of the gas produced about 30 c.c. of water, or 1 fluid ounce, and contained 0·3 grain of sulphur.

—	Hours.	Cub. Ft. of Gas Burnt.	Water.			Sulphur Oxides as Sulphur.		
			Formed. Cub. Cent.	Condensed. Cub. Cent.	Per Cent.	Formed. Grains.	Condensed. Grains.	Per Cent.
I.	3	19	564	20·8	3·7	5·7	0·20	3·5
II.	4	33	979	45·0	4·6	9·9	0·46	4·6
III.	4	28	831	327·0	39 3	8·4	2·54	30·0
IV.	4	32	949	143·0	15·1	9·6	0·94	10·0

It would appear, therefore, he said, that the condensation of the sulphur acids was proportional to the amount of the water condensed.

The next table showed the quantity of heat produced in these experiments, and the amount conveyed by the uncondensed water to the walls and ceiling.

Water.		Heat Produced. B.Th.U.	Water.		Heat Absorbed on Walls.	Heat per Cent.
Produced. Cub. Cent.	Condensed in Stove. Cub. Cent.		Deposited on Walls. Cub. Cent.	Per Hour. Cub. Cent.		
564	20·8	12,350	469·9	156·6	333·7	8·11
979	45	21,450	803·6	200·9	428 1	7·98
831	327	18,200	334·4	83·6	178·1	3 91
949	143	20,800	620·0	155·0	300·3	5·77

The water produced by burning coal gas, the author pointed out, was more than sufficient to dissolve all the sulphur acids; but as it only dissolved about its own volume of carbonic acid, it could not absorb more than 1-500th per cent. of the total amount of the gas formed.

Certain theoretical factors would assist in enabling them to predict the condition of a room in which flueless stoves only partially condensing were being used. The heated products containing a portion of the water and of the sulphur acids would ascend to the ceiling, and though not condensed in the stove would condense upon any cool surface with which they came in contact. An individual in the room was at a higher temperature; and provided he did not breathe immediately above the stove, it could be assumed that these two products would be condensed before he had to breathe the air. In the case of lime-washed ceilings or plaster walls, the

basic constituents of these were sufficient to fix the sulphuric acid produced by such stoves for many years. If care were taken in the construction of rooms and corridors to ensure sufficient circulation of gases, and sufficient area of such basic substances, the condensation of the acid water on other materials would be small. The sulphuric acid could not under any circumstances be re-volatilized into the air of the room, and even that deposited on glass or woodwork must be finally neutralized by contact with basic substances—such as soap or washing soda. It could therefore be said that a flueless stove, though imperfectly condensing, could under such conditions be utilized, and that the only determining factor was the carbonic content of the room, which would be determined by the volume of the gas burnt, and the natural ventilation conditions of the room itself. Pure carbonic acid contents of 60 volumes per 10,000 were not poisonous; it was only when 300 volumes were reached that respiration became slightly deeper and more frequent. Reductions of 5 to 6 per cent. in the oxygen content of the atmospheric air also did not seem to have any permanent injurious effects. If the suitability of a room for habitation depended on the relation of the humidity to temperature, these factors were controllable by most condensing stoves.

The author concluded his paper with the following remarks: "That gaseous carbonic acid cannot be regarded as an offender, is well seen in the recommendation of the Departmental Committee on the Ventilation of Factories and Workshops, where a higher limit of carbonic acid is suggested for gas-lit factories than for those in which no such lights are burning. As is pointed out in that report also, 'a moderate increase in carbonic acid and a diminution of oxygen in the air is not in itself prejudicial to health.' Since the above was written, the Coal Smoke Abatement Society have published a report on 25 different makes of gas-stoves, in which it is concluded that 'with plenty of ventilation, the flueless condensing gas-fires would be very suitable for warming rooms or passages.' I am inclined to add that, from the considerations I have put before you, flueless gas-stoves, especially those of a condensing type, are also indicated as an aid to defective ventilation."

At the conclusion of the paper, the Secretary (Mr. E. White Wallis) read a lengthy communication from Mr. T. W. Aldwinckle, F.R.I.B.A., who was unable to be present. The writer remarked that Dr. Rideal did not tell them one thing they would like to know—in what places, and under what conditions, he would recommend gas-stoves as being preferable to other methods of warming. The flueless gas-stove filled a place which could not well be occupied by any other kind of stove—gas or otherwise—such as in halls, passages, and staircases, where usually a flue did not exist. If, however, it was to be used in living rooms, work rooms, &c., it was necessary to look very closely into the hygienic aspect of the matter. For warmth, it would always be efficient, as the convecting heat must be large. But this was not the most important part of the question. Dr. Rideal said that, even with a good stove of this type, there would always be sulphur acids and a comparatively large quantity of carbonic acid. Architects held that there should not be more than 6 volumes per 10,000 of carbonic acid in a room; and therefore he was shocked to find from the paper that when one of these stoves had burnt six hours there were 80 volumes. A little later, Dr. Rideal stated that 60 volumes per 10,000 were not poisonous. Doubtless they were not; but were they consistent with health? An open fireplace, or even a gas-stove with a flue, not only warmed a room, but acted as a powerful exhaust ventilator; and without exhaust ventilation, it was impossible to secure a good supply of incoming fresh air, apart from mechanical methods. He felt sure there would always be serious hygienic difficulties with this class of stove, unless special ventilation was provided to meet the particular circumstances of the case.

The first speaker in the discussion was Mr. F. W. Goodenough, of the Gaslight and Coke Company, who confessed that the paper was disappointing to him in one or two respects—particularly because it dealt, practically exclusively, with condensing gas-stoves, and apparently only with those having luminous burners; whereas he thought, from the title, that the author was going to deal with all the various types of gas-stoves in use. He had hoped there would be considered gas-fires fitted in grates; those with flues without any hot-air chamber, and with hot-air chamber; condensing stoves with luminous burners, compared with similar stoves with asbestos and fire-clay lumps; and also non-condensing stoves of the American types. Perhaps, however, at some future date Dr. Rideal would deal with the whole subject more exhaustively. The recently published report of the Coal Smoke Abatement Society would form a good basis for this. The author, in his slight reference to gas-fires with flues, spoke of them as affording radiant heat only; the convection heat, he said, was lost. There were, however, few gas-fires used with flues that did not give a very material proportion of their heat as convection heat—especially those furnished with chambers that intercepted the products of combustion between the point where they left the so-called fuel and the exit into the chimney. He thought that with many gas-fires 30 per cent. of the heat would be convected heat, as distinct from radiant heat; but whether a large proportion of convected heat was really preferable or not was, of course, another question. Dr. Rideal made use of the expression: "It seemed reasonable to suggest that the time had arrived when the advantages of a flue did not outweigh the enormous disadvantage of loss of heat;" and somewhat earlier in the paper he remarked: "Only a fraction of the total heat is utilized." Of course, nine-tenths was a fraction; but he (Mr. Goodenough) took it the author meant only a small fraction. The tests made for the Coal Smoke Abatement Society showed that the loss of heat up a flue was not an "enormous" proportion of the whole. In fact, the tests were really too good to be true in this respect; for in one case it was stated that only 0·11 per cent. of the heat passed out through the flue. This sounded Utopian; but he thought the amount lost in the flue did not (with any efficient fire) exceed 25 per cent. of the total heat generated. Then, of course, the disadvantage of the loss of heat was accompanied by a corresponding advantage in the valuable ventilating effect of the draught created in the chimney by that heat. Doubtless defective ventilation had been the cause of most of the troubles that consumers had attributed to the supposed dry heat of gas-fires. The author had spoken of the "increase in the moisture of the air in the room which is desirable with the rise of temperature." Well, opinions might differ as to this; for everyone knew that a dry heat was more endurable than a moist one. It was a very unfortunate thing really that the tests of the Coal Smoke Abatement Society were made just too soon, because since the gas-fires were submitted to them by the different makers, other types had been put on the market which undoubtedly gave a better result than those tested. This was due to the adoption of the upright form of the so-called "fuel" or fire-clay lumps—giving a free way to the flame practically until the gas was all burnt. Thus there was no possibility of carbon monoxide being given off, and the true heat-value of the gas was secured. Then the fuel was in only one layer, which obviated loss from cold air passing up the fuel at the back. The fixing of gas and air regulators to stoves was another important improvement which enabled users to adjust the flame to meet local conditions. This should do a good deal to further popularize gas-fires. The other source of disappointment to him in the paper was that it did not contain as a conclusion a recommendation to the Committee of the Institute to withdraw their regulation against the exhibition of condensing stoves, to which the author referred. Certainly, the paper furnished some evidence which would justify the withdrawal, and the tests of the Coal Smoke Abatement Society afforded further evidence. The latter showed that the increases in carbonic acid were much lower than the theoretical figures given in the first table of the paper. The table stated that with a stove burning 10 cubic feet of gas an hour the carbonic acid in a room with a capacity of 4000 cubic feet would rise from 2 to 80 parts per 10,000 after six hours' burning; whereas one of the tests of the Coal Smoke Abatement Society, with a stove burning 14 cubic feet of gas per hour, showed an increase only from 5·3 to 8 volumes per 10,000. The increase shown in some of the tests of stoves with flues was quite as much, and was attributed by the examiners to the effect of them being in the room and exhaling carbonic acid during the test. No doubt the prejudice against gas-stoves, which still existed in some minds, was disappearing; and he quits hoped that the paper, together with the report of the Coal Smoke Abatement Society, would assist in removing that prejudice. He wished to say, on behalf of gas companies in general and his own in particular, that if any of their consumers had any cause to be dissatisfied with any gas-stoves or other apparatus they had in use, they (the gas companies) wanted to be advised of the fact, so that they might put their services at the disposal of their consumers for the purpose of discovering and remedying the cause of the trouble. Otherwise, the result was unsatisfactory to user and seller of gas alike. There were badly constructed and badly fitted gas-stoves in existence—some of those fixed by so-called gas-fitters being a disgrace to the trade; and he was only anxious to know of them, and get matters put straight, so that everyone might be satisfied.

Disagreement with almost all that the author had brought forward was expressed by Professor A. Bostock Hill, M.D. He admitted that it was only by the use of gaseous fuel that they could overcome many of the difficulties that arose in connection with the pollution of the atmosphere of towns and the production of irritating fogs; also that in the past there had been a great amount of prejudice against gas-fires, particularly on the part of medical men, which was entirely due to a misapprehension—due, in fact, to the improper construction of gas-fires when first introduced, and not to any difficulties in the use of gas at the present time. But he considered Dr. Rideal's paper a crushing indictment of the flueless stove. The author spoke of a room of 4000 cubic feet capacity; but it was not often (particularly in the case of bedrooms) that they came across rooms of this size; and in a smaller space, of course, a stove would exercise a greater polluting influence. It was suggested that the quantities of carbonic acid that would be present in the air would not be prejudicial to health; but he disagreed with this. The chief point he took exception to was the suggestion that they should give up their sanitary ideas of the purity of atmosphere; and because it might be inconvenient in some instances to remove polluting products of combustion, they might, with perfect confidence—with the feeling that they were doing no harm—allow them to come into their atmosphere. This he was not prepared to accept on the evidence brought forward; and he was afraid that Mr. Goodenough would remain disappointed some little time longer with regard to the Committee of the Sanitary Institute withdrawing their objection to the introduction of flueless stoves into the exhibitions.

Surprise was expressed by Mr. A. Saxon Snell, F.R.I.B.A., at

the statement of the author that gas was economical as a fuel; he thought the experience of most of those present was contrary to this. It was only economical when the fire was required for a short time. He also noticed that Dr. Rideal ignored the value of the open fire as a ventilator.

The next speaker was Dr. H. A. Des Vœux, who remarked that he was connected with the gas-stove tests of the Coal Smoke Abatement Society, which were conducted primarily with a view to discovering whether they were hygienic, and secondly from an economical standpoint. He thought the claims in the paper with regard to flueless stoves corresponded almost exactly with the results of the tests he referred to. The figures were a little different; but variations in the conditions of testing might easily account for this. He could not, however, agree with all the author's conclusions. Whether a flueless stove when put into a room was hurtful, was a debatable question; but he should take the side that in a room with no other ventilation than the air coming through the walls and crevices under the door, &c., it would be extremely detrimental to health. The carbonic acid the author obtained, added to what would be produced by the people in the room, would make an amount that would be very dangerous to health. It would be wrong to recommend flueless stoves in sitting or bed rooms without very efficient ventilation. He was brought up to think all gas-fires were dangerous, and that it was risky to allow a patient to be in a bedroom with one; but he had now come to believe in gas-fires when properly set in the chimney. They were very efficient heaters; and though perhaps not so cheap as coal, they had many other advantages —particularly where it was desirable that a patient should not be disturbed. For the last few years, in all cases of long illness, he had always ordered a gas-fire to be put into the bedroom, and had never had any reason to regret it.

Dr. Glover Lyon said the idea of letting the fumes of badly-consumed gas escape into a room was very wrong. As to the diminished oxygen, there was nothing to be said; diminution of oxygen had no relation to ventilation. With respect to carbonic acid, the amount in the air was of no importance whatever; it never amounted to anything like a proportion that would be of the slightest consequence to health, or even to comfort. In soda-water factories, they worked with up to 5 per cent. in the air; and then the people began to faint.

It was remarked by Mr. J. Osborne Smith, F.R.I.B.A., that he had often been asked to supplement in class rooms an open fire with a flueless stove, but had refused. He did not believe in putting anything into a room for the sake of generating heat that would tend to render the atmosphere more or less impure. He admitted that gas people had done much work during the past ten years. They had gone into the question scientifically, and were now producing much better stoves than formerly, though not yet perfect.

Referring to the question of carbonic acid, Dr. J. S. Owens said he agreed that there was this danger—that on account of the carbonic acid displacing the oxygen, it caused an increase in the number of respirations per minute, and so increased rapidity in the absorption of other poisons. As to condensing stoves (with the recent tests of which for the Smoke Abatement Society he was connected), there was one important point—that carbon monoxide might be given off when any little thing went wrong. If they could be certain that carbonic acid would be the only impurity present, it would be all right; but they could not be sure of this with flueless stoves. As to the percentage of heat passing out with the flue gases in the tests referred to, he thought there was a slight misunderstanding, because the figure given in the results was the percentage loss out of the top of the flue. Much therefore depended on the length of the flue—with the shorter flues, there would be a higher percentage of loss. In previous tests made for the Society, the flues were 68 feet high; and roughly there was a loss of 15 per cent. with the flue gases. In recent tests with similar fires, the flues were 53 feet high; and the loss ran up to 21 and 22 per cent. These were both with coal. The gas tests were mostly conducted with flues about 68 feet long; but in one case, in which the flue was 23 feet, the losses were most remarkable—about 50 per cent. The presumption was that the actual amount of heat passing into the flue was very high—it was a different thing to the amount passing out of the flue. This was where some mistakes had arisen. It had been said that the arrangement of fuel had been altered since the tests were carried out; but he might say that it was placed very carefully, so that the apertures in the lumps were well over the burners, and it was well separated from the burners to prevent impinging of the flame on a cold surface. Some were single, and some double rows of fuel. As to the carbonic acid in a room heated by a condensing stove, as compared with the theoretical figure, the room was not hermetically sealed, and, as stated in the report, the floors were of coke breeze concrete, which allowed of the passage of air. One of the tables included in the report showed that the cost of gas for heating, at 3s. per 1000 cubic feet, was from two to four times as much as the best coal-fires. He was strongly of opinion that in every other respect gas-fires, with good flues and thorough ventilation, were better than, or certainly as good as, coal-fires.

Mr. A. J. Martin remarked that a flueless stove not only produced carbonic acid gas, but also heat; and before the carbonic acid in a room could reach a dangerous amount, the heat would become unendurable. The last volume of "Proceedings" of the Institution of Civil Engineers contained some observations on the lighting of two rooms—one by gas and the other by electricity; and though there were only the crudest means of ventilation, the carbonic acid was actually less in the room lighted by gas than in that where electricity was installed. Therefore they were quite justified, he thought, in taking it as probable that the presence of a flueless gas-stove in a room would help rather than hinder the ventilation.

One of the speakers who took part in the discussion—Dr. Hurtley —remarked that when carrying out some tests he found in a room with 58 volumes of carbonic acid per 10,000 no inconvenience, except that it became very hot. He was in the room perhaps an hour. Mr. W. H. Y. Webber said the question of the hygienic aspect of flueless gas-stoves had been taken exclusively on one footing—that was, the consideration of a certain possible amount of atmospheric contamination. He hoped that when the doctors came to look into the matter a little more, they would weaken in their wholesale condemnation of the flueless stove; and by way of leading them to that, he would like some of them to serve a little time in workshops and other places where, if there were not a flueless stove, there would be no means of heating at all. After a disciplinary treatment of this kind, they would think a little less of the purely hypothetical atmospheric conditions of the use of an article which was never employed unless there was plenty of ventilation. Here several members exclaimed that they had seen flueless stoves in bedrooms; and Mr. Webber replied that he certainly did not approve of them in places like that. He did not, he added, think the proper use of any apparatus ought to be condemned wholesale because in some cases it was abused.

The Chairman wound up the discussion with a few remarks, in the course of which he said the question was a difficult one on which to come to a definite conclusion; but at the same time, as a medical man, he thought it was not within their province at present to say that gas-stoves which had not flues were suitable for bedrooms, schools, or inhabited rooms. There was no intention on the part of the profession to "boycott" flueless stoves for places—passages, &c.—for which they were suitable.

In reply, Dr. Rideal said the paper had exceeded his expectations. He brought it forward in a way which he thought would provoke a good discussion; and it had done so. The paper had not satisfied either those interested in gas-stoves or the medical profession. His own views on the subject had been omitted. The only remark he ventured to make was the one in conclusion, in which he expressed the opinion that flueless stoves, especially those of the condensing type, might be looked upon as an aid to defective ventilation; and he had not heard anything, either from the advocates of gas or from medical men, to cause him to alter this opinion.

Junior Institution of Engineers.

Last Saturday week, on the invitation of the President, Mr. W. B. Bryan, M.Inst.C.E., the Chief Engineer of the Metropolitan Water Board, a large number of members of the Junior Institution paid a visit to the Honor Oak reservoirs which are in course of construction, under the direction and supervision of Mr. J. W. Restler, M.Inst.C.E., by whom they were designed. Mr. Bryan, assisted by Mr. F. Melhuish and other members of the staff, conducted the party over the extensive works, referring to the features of special interest. The reservoirs, as has already been pointed out, will contain nearly 60 million gallons of water, and will probably be the largest covered reservoirs in the world. The construction generally is of brickwork and concrete, with walls separating the reservoir into four divisions. A middle wall, 3 feet in thickness, extends all round the outer walls, and is keyed into the clay. At the centre of the four reservoirs will be the central well, from which the charging and emptying will be directed. The bricks used have all been made from the excavated clay on the site—some 16 million bricks so far having been produced. The existing engine-house and well-pumps were inspected; and at the conclusion of the tour the President entertained the members to tea in one of the store-rooms. Afterwards a vote of thanks was passed to Mr. Restler and his staff for the arrangements carried out for the reception of the Institution.

Progress of the Perth (W.A.) Gas Company.—In the "JOURNAL" for the 18th of September last, we gave, from a letter received from Mr. W. G. Quicke, on the subject of the severance of his connection with the Perth (W.A.) Gas Company, some particulars in regard to the progress of the Company under his management. We learn from a communication, dated the 3rd of November, addressed to us by Mr. E. Wigglesworth, the General Manager, that the statements referred to are misleading. He says the increase in the supply of gas has been nothing compared with that experienced in the Electricity Department, and chiefly for the street lighting to meet the City Council's intentions with respect to purchase. As to the designs which Mr. Quicke claims to have altered mainly to suit incandescent burners, he states that they had been in use for more than a year when that gentleman arrived; and the pillars and lanterns were erected by Mr. Wigglesworth quite 22 years ago. He adds that the Company's balance-sheets will show that they could not have paid half the dividends they have declared for the last five or six years, if no greater profit had been made in the electricity than was realized in the gas department.

THE ASSOCIATION OF WATER ENGINEERS.

WINTER MEETING, DEC. 8, 1906.

PAPERS READ.

(1)

COPPER SULPHATE FOR WATER FILTRATION.

Dr. ADOLPHE KEMNA (Antwerp) read a paper on the above subject, of which the following is an abstract.

The author began by pointing out that each of the two principal modes of water supply has its advantages and its drawbacks, and that the not always easy task of the engineer is to strike a happy medium according to local circumstances. The water coming out of the ground as springs, or taken from wells and drainage galleries, is considered as "naturally pure;" and, once secured, the only further task is distribution to the consumers. But that postulate of "natural purity" is not always legitimate; and through most disagreeable experience engineers have learned how necessary it is to get some knowledge of the geological conditions which govern the purifying action of the underground strata, as well as a knowledge of geography, to ascertain possible causes of contamination. At present, and for several years past, a thorough bacterial analysis is an absolute requisite before a spring or an underground water can be accepted as a source of supply. The chemical composition of an underground water is unavoidably dependent upon the chemical nature of the strata. Quantity is a more important question. It is a popular belief, not only with the public at large, but also with some engineers and hygienists, that underground water is inexhaustible; but nearly all springs are affected by the weather yielding less in a dry period, just when the requirements are greatest.

With underground waters and springs, while quantity needs very careful consideration, and securing the water from a distance or from underground involves very great capital expenditure, the chemical composition, within large limits, gives only slight trouble, and the hygienic purity can be relied upon, on the whole, and the water can be used as it is without being treated or "doctored."

Surface waters are always liable to pollution, and must be dealt with as if they were really contaminated. In their natural condition, they are simply to be discarded altogether. This is the more tantalizing, as nearly all cities have sprung up on the banks of large rivers, and the whole yield of the geographical watershed passes by in close proximity. There is generally no mistake possible about quantity; no fear of any shortage to be entertained. The water is much less mineralized, and not so hard; and only a short line of pipes is required. It is in the logical sequence of things that engineers should try to avail themselves of these favourable circumstances, by submitting the water, prior to distribution, to a treatment which would purify artificially, and reproduce the action of Nature. Hence was evolved the sand filter, which has been such a boon to mankind.

In a paper read in 1899, the author dealt with one class of the troubles which beset the filtering engineer, and enumerated a formidable array of animals and their wily ways of playing mischief. But, on the whole, they are relatively easily controlled and cannot do real harm. Things are more serious with floating plants, as they cause odours and taste. From a hygienic point of view, there is not the slightest danger in a water rendered unpalatable from this cause, but at times the taste is so pronounced as to be nauseous, and interferes with the normal consumption, so that people will turn to any other water which they can secure. The danger in this case is that shallow wells and other sources of doubtful quality may be the only alternative available. As pointed out in the paper referred to, a growth of fixed organisms is not necessarily a cause of pollution. Even when the bottom and the sides of a large reservoir are thickly covered with growth, the amount is small in comparison with the bulk of the water. The larger the animal, the easier it falls a prey to man. Smaller animals, under favourable circumstances, are much more prolific and difficult to keep within bounds, and may become very troublesome indeed, as, for example, rabbits both in Australia and California, rats in seaports (so dangerous from their tendency to disseminate plague germs), and mosquitoes, from their being the vehicle of yellow or malarial fevers. For all these animals, their smallness is a protection, and their numbers render them dangerous. This is exactly the case with floating algæ and protozoa in water, against which the engineer is often powerless.

There is, however, a very simple way of avoiding the evil —viz., by keeping out the light. No light, no plants; no plants, no phytophagous animals; no plant-eating animals, no carnivorous animals. The suppression of light cuts the evil at the root. This, however, is easily said, but not so easily done. Sand filters may be covered instead of being left open to the light—in fact, covering is necessary in places where winters are severe. But the cost is considerable; and in the case of large impounding reservoirs it is, of course, utterly prohibitive.

The author went on to say he had made some observations tending to show that the case is not absolutely desperate. During the summer of 1904, he used sulphate of alumina, not so much as a coagulant to get rid of suspended clay, but to reduce the yellow colour of the water. This worked satisfactorily, and at the same time, although the summer was very hot, practically no floating algæ developed during the first few days of the life of a filter. Later on, when they appeared in large number, the filter had then done a fair share of work, and its loss of head, though not reaching the maximum, had sufficiently increased to allow of the filter being thrown out of use, with the trifling disadvantage of being cleaned a couple of days earlier than it would otherwise have been.

As regards algæ, the first days are the best, because there has not been time for them to multiply, and they have not yet accumulated on the surface of the sand. But during these first days, the rate of filtration is slow; and the speed cannot be increased until a good surface film has been formed. But if the speed of filtration is then increased, the risk is run of the algæ having grown too abundant and imparting taste. In order to get the best results, contradictory conditions are to be realized, which seems impossible. The difficulty was overcome in the following way: When a filter had been cleaned and was to be filled again, a small quantity of sulphate of alumina was added to the inflowing water, so as to give at once a loss of a head of a few centimetres, and encourage the formation of a surface layer. The normal speed could be given sooner without any harm to the bacterial composition of the effluent. A very striking feature in that year (1904) was the persistency of blue algæ on the filters, and especially in the intake reservoirs. They remained in noticeable quantities till the middle of November, when they were only got rid of by a complete cleaning of the reservoirs.

In the above-named year, there was published Bulletin No. 64 of the Bureau of Plant Industry at Washington, which showed that sulphate of copper in proportions of 1 part in several million parts of water kills algæ without the least injury to higher plants or animals. This conclusion was arrived at as the result of investigations extending over several years by Messrs. G. E. Moore and Karl F. Kellerman. They showed that, practically speaking, it is impossible to prevent the algæ from growing, and we cannot protect the water from their bad influence. The only way is to kill them; and this is best done by poisoning them. But while the toxic must destroy the algæ, it must not harm higher animals and plants; therefore fish were constant, but probably unwilling, contributors to the experimental work. The substance must be cheap and readily applied by unskilled labour; and as sulphate of copper alone complied with all the conditions, it was further experimented with.

The first application of sulphate of copper to a waterworks was made in July, 1903. A company in Kentucky had always been in trouble from odours from a reservoir. The first two seasons, the explanation of "decaying vegetation" was accepted, and left some hope for the future. But things went from bad to worse; and when the Bureau interfered, a preliminary determination of the organisms was made. The predominance of blue algæ (*Anabæna*) made it probable that a weak solution of sulphate would answer. A quantity

sufficient, with the water present in the reservoir (25 million American gallons), to make a solution of 1 to 4,000,000 (say 50 lbs.) was tied in a coarse sack, attached to a boat, and dragged over the surface of the water. The following day there was already a "very decided" decrease; after 48 hours the surface had lost its blue-green colour, but was brown from the dead organisms; and after about a week blue algæ could no longer be found.

The publication of Bulletin No. 64 resulted in a busy time for the Bureau. A great many water engineers, proprietors of fish-ponds, or of estates with ornamental lakes, all required assistance and directions; and they obtained what they wanted. The results are summarized in Bulletin No. 76, issued April, 1905, which contained the signatures of qualified engineers, medical officers of health, and managers and chairmen of large undertakings, all referring to the treatment as an unmitigated success. The contention of the authors, that "the work can no longer be considered in an experimental stage," is completely borne out. The fact that copper, acting so powerfully on lower organisms, was, in the proportions used, innocuous to man, was duly considered in the first bulletin; but the second bulletin takes the matter up again, and deals with it at greater length, as there was some prejudice in many quarters against the treatment.

As mentioned on a former occasion, algæ were only present in the Waelhem works of the Antwerp Water Company in small quantities during the years 1904 and 1905; so that there was no occasion then to resort to the sulphate of copper treatment. But in August of the present year, after the very hot weather experienced at the beginning of the month, the water in some filters turned green, and after running for about six days, the filters showed traces of free ammonia, and some faint indication of taste. Though this was hardly perceptible, the filters were stopped and cleaned, in order to be on the safe side, though they could have run several days longer. It appears that, with a certain amount of growth of floating organisms, there is, after a few days, an accumulation of decaying matter on the surface of the sand, which contaminates the water and impairs the purifying action of the normal bottom-dwellers. This organism proved to be *Eudorina*, which is a Flagellate. The Flagellates are a very extensive group with a great variety of forms, some being colourless, and taking as food still smaller organisms, such as bacteria or organic particles. Like most other lower and primitive organisms, they multiply by division.

As *Eudorina* was multiplying in his filters, and threatening to become noxious, the author decided to apply sulphate of copper in a dose of 1 per million, calculated upon the quantity of water above the sand, *plus* that contained in the sand (which was estimated on a porosity of one-third), and the amount of water to be delivered into the filter. The water was first lowered in the filter to 1 foot above the sand; and the required quantity of salt was dissolved in a cask with a tap at the bottom, which was placed over the inlet—the tap being regulated so as to give the necessary proportion of the salt. The inlet to the filters being an open channel with steps forming a cascade, a thorough mixture was easily obtained. Only one filter was used for this purpose, so as not to interfere with the general supply. Filter No. 4 was cleaned on July 30, and filled and restarted next day.

On Saturday, Aug. 4, the plankton net showed a marked development of *Eudorina* and Rotifers, though the effluent was good, and only a faint trace of taste could be detected. The sulphate was applied at 4 p.m., and after 36 hours the result was most marked. A haul with the plankton net showed only a few organisms, and contrasted strongly with the rich vegetation in the other filters. As, however, there had been a sudden increase in the loss of head, and the effluent showed traces of free ammonia and a very slight taste, the quantity of sulphate of copper was reduced by one-half (1 part to 2 millions); and on the following day, Tuesday, Aug. 7, though the organism had again diminished, the free ammonia was on the increase, and the taste a little more marked, so that the effluent was turned to waste into the intake reservoirs, the filter being still kept going.

As soon as ever the slightest trace of taste appeared, the speed of the filter was diminished to 5 centimetres per hour, as a precautionary measure. The loss of head showed only a small diminution, and remained practically constant from Sunday till Thursday, when it began to increase. At the same time, there was an improvement in respect of free ammonia and taste; so that on Sunday, Aug. 12, it was considered quite safe to again utilize the effluent. The filter was turned on the clean-water tank, and the sulphate of copper stopped. The loss of head increased rapidly, and on Thursday, Aug. 16, the filter was shut off for cleaning.

During the first days of its life, though the loss of head was *nil*, showing the absence of a film, the bacterial results were excellent. The sulphate of copper treatment coincided with a pullulation of microbes; the plates of three successive days being rapidly liquefied. Those of Thursday, Aug. 9, showed 10,000 colonies; but the next day the figure had diminished by 90 per cent. When the filter was restarted on Saturday, Aug. 18, there was for three days some free ammonia in the effluent, and for ten days there was no loss of head; and, though speeds of 7 and over 8 centimetres per hour were allowed, the bacterial results remained quite satisfactory.

In concluding his paper, the author said: We may now reconsider the facts, and see how they can be explained and what they teach. First of all, there was the rapid destruction of organisms, and especially *Eudorina*. Instead of being able to stand a dilution of 100,000, it was killed by 1 in 1,000,000. This organism was therefore not at all so resistent as the investigations of the Washington Bureau seemed to indicate. Another unexpected result was the disappearance of most crustacea. *Daphnia* were numerous on the filter; but the sulphate of copper dealt also very efficiently with them. A very noteworthy fact is what may be called the after-effect of the copper sulphate. When the filter was restarted after being cleaned, though no sulphate was added, the loss of head remained *nil* for ten days. After the second, third, and fourth cleanings, the same effect was still noticeable; and at the moment of writing [Nov. 8], the curve of the loss of head of that filter (No. 4) still contrasts with all the other filters. It seems as if there were a greater difficulty to start growth, though the biological examination of the surface layer when cleaned shows no difference from that of other filters. The copper salt does not remain in solution; there are various causes of precipitation; and it is possible that the grains of sand get coated with a layer of the precipitate, just as they get coated with iron. This may be of some practical importance, but requires further investigation. There is, however, no denying the fact that the first effect of the sulphate was to make things worse; the filter was bad during at least six days. As far as the author knows, there is no other record of the application of sulphate of copper to ordinary sand filtration. Its use in water supplies is an excellent illustration of the relationship which ought to be established between theoretical science and practical application.

Discussion.

The PRESIDENT (Mr. W. Millhouse) said he was sure the heartiest thanks of the members were due to Dr. Kemna for the admirable paper he had read, and also for the great care he had taken in placing such purely scientific knowledge before them in a manner so easily understandable. He (the President) had gone a very small way indeed in the use of sulphate of copper, and with very happy results. But he would not go so far as to say that it could be mixed with water that was to be distributed for consumption. That was an open question which only time could answer—that was to say, as to whether or not it was advisable to use it. Personally, he should say: "Decidedly not, unless compulsion renders it necessary."

Mr. W. H. HUMPHREYS (York) said that his attention had been directed to this subject for the past two years, as they were troubled during the summer months with a growth of algæ on their filter-beds. Fortunately, there was nothing particularly objectionable, so far as smell was concerned, but its growth was so very rapid that it speedily blocked the filters and caused them to be laid off for cleaning. Copper sulphate, or blue vitriol, they all knew to be a poison. Fortunately, he thought, its use in this country with a water supply was almost non-existent. The only case he knew of was an experiment tried very successfully by Dr. Howard Jones, for the removal of algæ only from certain reservoirs at Newport (Mon.). The use of sulphate of copper might be perfectly safe in the hands of an expert chemist; but personally—and, of course, he spoke as a water engineer only—he would shrink from using a poison in any water supply he was connected with, and he could not recommend others in a similar position to do so. In fact, he would go even further, and say that anything of a poisonous character

should not be allowed to be used in a public water supply. He was quite satisfied that the results stated by Dr. Kemna and others were proof that the growth of certain objectionable forms of algæ could be prevented by the use of copper sulphate; but he was not satisfied with the means. And when the author told them that the only way to get rid of algæ was to kill them, and that the only way to do this was by poison, it seemed to be introducing an element into a water supply, at, in his opinion, some considerable risk. He could better illustrate what he meant by "risk" by quoting an example. Dr. Clarke, a Chemist of the State Board of Health of Boston, began an experiment in 1904, in order to test the value of copper sulphate in purification. A filter, 17 ft. 4 in., was used, containing 2½ feet of sand. He commenced with 1 part of sulphate in 1,000,000 parts of water, and varied the quantity occasionally; the greatest amount used during the year of experiment being 1 part in 133,000 parts of water. The copper sulphate was applied directly to the water upon the surface of the filter; but the volume of water always above the sand allowed a storage of water, after introducing the sulphate, of from five to eight hours. Examination of the sand of the filter from time to time during the experiment, and after the experiment had ended, showed the accumulation of a large amount of copper in the sand, and also showed that the copper penetrated the entire depth of the filter. At the end of the experiment, the amount of copper in the surface sand of the filter was 22·8 parts per 100,000; at a depth of 12 inches, 7·6 parts per 100,000; and at a depth of 24 inches, 6·8 parts per 100,000. Giving these results in terms of copper sulphate, the surface sand contained 89·5 parts per 100,000; at 12 inches, there were 79·8 parts present; and at 24 inches, there were 26·6 parts. Analyses of the effluent of the filter showed that this effluent contained copper, calculated as sulphate, varying in amounts at different times from 1·2 parts to 5·8 parts per million parts of water. At the end of August, 1905—three months after he had ceased to add copper sulphate to the applied water—the effluent contained copper, calculated as sulphate, to the amount of 3·7 parts per million parts of water; showing that copper was continually being taken into solution from the deposit within the filter. The actual volume of water passed through this filter daily varied from 14,000 to 26,000 gallons, and the rate of filtration from 2,800,000 to 4,700,000 gallons per acre daily. Summarizing his experiments, he said that poorer results in water filtration were obtained when using copper sulphate than when operating the same filter without the use of the copper sulphate. A poorer effluent, organically, was obtained; and there was an accumulation of copper upon the sand in the filter that would eventually—if copper in the form in which it remained upon the sand had any strength at all as a bactericide—reduce the efficiency of the filter very greatly. In other words, the biological actions upon which good results with slow sand filters depended would be badly impaired. For the purposes of purification, they might consider that the use of copper sulphate was only in its experimental stage; and he had seen the results of several experiments which did not bear out its capacity as a remedy for the removal of bacteria from water. The subject was still in its experimental stage; and so far they might conclude that there would be no danger to the public health from the use of moderate quantities of copper sulphate of (say) 1 part to 1,000,000 employed occasionally for the removal of algæ, but then only in the hands of a skilled chemist. To use it as a purifying agent continuously must be looked upon with the greatest suspicion; and he hoped it would not be attempted in this country under present circumstances.

Mr. F. R. Hull (Rothbury) said it was known that in sand filtration the diatoms in the scum were the principal filtering medium; and it would be interesting to know what effect the copper sulphate had on them. If it was strong enough to kill the algæ, it would also, to a certain extent, kill some of the diatoms, and therefore spoil the efficiency of the filtering scum. He should also like to know what was the effect on bacterial life when, after the addition of copper sulphate, the dead algæ became decomposed, giving matter upon which the bacteria could thrive. It appeared that the water should be run off for some days; and it would be desirable to know approximately the length of the period during which the water would have to be wasted.

Dr. J. C. Thresh (Chelmsford), called upon by the President, said he had attended the meeting not for the purpose of speaking, but of learning something; for there were very few observers who were more competent to deal with this question, and in whom they had more faith, than Dr. Kemna. They believed he had the best possible grounds for his recommendations; and therefore that they were well worth consideration by the members. The conditions in this country, however, differed very much from those with which Dr. Kemna had to deal. Personally, he did not desire, if it could be avoided, to put sulphate of copper into water; and he thought they would never want to add copper continuously to improve the quality or appearance of a water. Water in this country, if not sufficiently pure without this chemical, he should think would not be pure enough to be used for the purposes of a public supply. He took it that what Dr. Kemna really suggested was that a certain amount of the copper sulphate might occasionally be used with very great advantage. He did not gather that Dr. Kemna actually recommended it, but thought it worth consideration—in the one case to assist filtration, and in the other to prevent the growth of odour-producing organisms. The only reason that could be given for its use in assisting filtration would be to save the expense of the more frequent cleaning out of the filter-beds. He (Dr. Thresh) preferred a preliminary coarse sand filtration, whereby it was rendered impossible for these larger forms of life to get on to the fine sand filter in any quantity. On the whole, he thought the occasions that would arise when it would be justifiable to use sulphate of copper to assist sand filtration would be very rare indeed. Then there was the question of preventing the growth of the odour-producing organisms, which tended to appear especially in autumn time. In America and other countries, this was a constant occurrence every autumn; but in this country, it was a rare occurrence. Perhaps the engineer was troubled by it once or twice in a lifetime; and the question was whether he would be justified in using sulphate of copper on these occasions. Speaking as a medical man, one would say there would be the strongest possible objection to copper being used continuously, or as a matter of routine. But he did not think there would be any objection to its being used occasionally on emergency, especially if precautions were taken to pass the water finally through some ferruginous substance that would remove the last traces of the metal. If the slightest trace was found in the water as supplied to the consumers, they might be charged with attempting to poison the community.

Mr. E. Sandeman (Derwent Valley) said he should like to relate an experience that he had had. About eight years ago—in the autumn of 1898—he was filling a new storage reservoir on Dartmoor, which contained 650 million gallons. It was filled about the end of January, 1899; but in the following summer the water became very objectionable. Although they did their best, by opening the valves at the bottom of the reservoir, and letting out as much of the water as they could spare, there was no improvement—in fact, as the summer went on, it became worse. The water acquired a most unpleasant smell, and a yellowish colour, besides being slightly turbid. It was so bad at the bottom of the reservoir that the men who opened the discharge-valves could not stay there. Mr. Ward, of Boston, who had had trouble with water giving an unpleasant odour in summer time, advised him to cause it to run along open channels exposed to light and air. Fortunately there was from the watershed on Dartmoor to Plymouth the old Leat, made by Sir Francis Drake. He turned the water through this channel; and it ran in the open, exposed to light, sun, and air, for a distance of eight miles. This treatment practically disposed of the smell; and the colour and turbidity were somewhat better. Analyses were made constantly throughout the whole of the summer of 1899; but there was nothing of a deleterious nature found, and the Analyst always reported the water as fit for domestic use. If the method suggested by Dr. Kemna could be adopted in a case of the kind he had described, it would be a great advantage. He should like to ask Dr. Kemna (he had seen it so stated in an American paper) whether scum containing sulphate of copper rose to the surface of the water, and whether it could be cleared off. If so, this would do away with some of the disadvantage referred to by previous speakers.

Mr. C. Clemesha Smith (Wakefield) said the remarks just made by Mr. Sandeman reminded him of a somewhat similar experience; but fortunately the reservoir filled in this case was for compensation purposes only, and there was no complaint. He had followed from time to time various articles in the technical journals with reference to the copper

treatment, and had noted with interest that, in addition to its effect upon algæ, many experiments had been made dealing with the effect of it upon various bacilli. Although Dr. Kemna had not dealt with this question, perhaps he might be allowed to refer to it. Dr. Kraemer, of Philadelphia, had told them that typhoid and colon bacilli would yield to the influence of copper, and that "samples of water kept at room temperature for 48 hours showed a 99 per cent. reduction of all micro-organisms when dosed with 1 part of copper sulphate per 100,000, and 90 per cent. when the dose was only 1 part per million. This side of the question was perhaps worth consideration—not for the general use of sulphate of copper, but for cases of outbreak. If it could be employed with safety, it would be of great use to water engineers in cases of emergency. But it seemed to him that the point raised by Mr. Humphreys should be settled. Could they safely use copper sulphate? They were told by some authorities that it was perfectly safe when diluted, and might be ingested over long periods without any great harm arising. Others said that great care must be exercised in the use of the reagent, and its use was prohibited as a food preservative. They were therefore rather at sea; and what they wanted was some definite information as to the effect of copper on the human system.

Mr. J. S. Pickering (Cheltenham) remarked that considerable doubt had been expressed as to whether water engineers were justified in recommending this treatment under any conditions in this country. While in England they were still debating its merits and demerits, the Americans had practically abandoned all discussion, had brought the system into practical use, and a considerable number of reservoirs in the United States were now being regularly treated by copper sulphate. It was a matter rather for the medical profession than for the water engineer, as to what the result on health might be, and as to whether there was likely to be any injurious effect in the use of sulphate of copper in such small quantities as those recommended by Dr. Kemna and by experts who had carried out the trials in America. He should like to know whether he understood Dr. Kemna aright, that there was no danger, from a hygienic point of view, from the use of water polluted with algæ. If this were so, it was contrary to what he (Mr. Pickering) had always understood. He should like Dr. Kemna to say whether he considered such pollution merely made the water unpalatable, and whether, assuming it was organically pure in other respects, it could be used without danger to health. He had to deal with a water not of the character described by Dr. Kemna or the American experts, but a spring water from the oolite formation. In its natural form, if it could be used fresh from the spring, it was an excellent water—a better water it was almost impossible to secure; but on storing in open reservoirs a plant known as *chara fœtida* grew in great profusion. For two or three months of the year, the water gave considerable trouble in the way of unpleasant odour and objectionable taste; and it was now a question whether this wholesome supply of water—wholesome if it could be used fresh—should be abandoned, or whether it could be treated with copper sulphate. Therefore to him personally this was a subject of the greatest interest. He might say that the water had given trouble for nearly sixty years. Last summer they passed it through a closed reservoir; and for the first time in the history of the water-works, there was not a single complaint. This went to prove what Dr. Kemna had stated, that if they could only deal with this class of water in the manner described, there would be no further difficulty. But in his case it was not always practicable; and he had to deal with 30 million gallons in open reservoirs. He should like Dr. Kemna to state—supposing they treated the water with copper sulphate possibly two or three times a year—what was to become of the precipitated matter, and what would be the effect supposing it should accidentally get into the mains. He was glad to have the assurance of Dr. Thresh that they might, under certain conditions, employ the sulphate of copper treatment without fear. But he (Mr. Pickering) did not think it was a matter for which the water engineer should take any responsibility. He ought to leave this to his colleague, the medical officer, or to some other expert.

Mr. William Whitaker (Croydon) wished to say a few words on broad general principles, to which, he thought, the paper referred largely. It was an illustration of the common purposes of science and practice, which was a very important thing. They could not divorce scientific and practical work. The two must go together for the good of both. What was good in small things was often true in large ones also. What had Dr. Kemna shown them in his illustrations? Colonies protected or enveloped; colonies unprotected; and, again, colonies well compacted, and others more isolated or scattered—with the result, success, on the one hand, to protection and consolidation; on the other hand failure, where these were wanting. Was it not the same on a large scale in water-works? With isolation and want of protection, there might be failure; with combination or federation and protected areas, success.

Mr. Frederick Griffith (Leicester) remarked that the bacteriological study of fresh water algæ was one of great interest. He might say that Leicester had had experience and visitations of algæ in several of the reservoirs; and the results had been precisely similar to those already explained by different speakers. Having regard to the fact that copper was detrimental to health unless judiciously used, but that if it was employed with care, and due consideration was given to the results they might hope to obtain from the information derived from such papers as that of Dr. Kemna, as well as from his experience and that of their friends across the Atlantic, he thought they ought to further investigate the subject. He would therefore ask the President and Council to cultivate closer ties with the Bureau in Washington who were investigating in such an able way the subject of the sulphate of copper treatment of water.

Mr. Baldwin Latham (London) said sulphate of copper had been used upon the works at Newport (Mon.) with considerable success. But he did not think that copper was the only thing that could be employed for the purification of water. As the members knew, experiments had been made in Paris with ozonized air, which had exactly the same effect in sweetening water without any deleterious or dangerous results; and, in addition, the microbes were destroyed or removed in larger proportion than was done by sand filtration. So far as the question of copper being injurious was concerned, no doubt it was so if taken in poisonous doses, and it would be cumulative in the system. But sulphate of copper when applied to water would be precipitated, and there would be none left in it—just the same as sulphate of alumina. Water that was very pure was not subject to the attacks of algæ that were found to exercise a very unpleasant influence. The water which suffered was usually that containing a fair quantity of solid matter; and this would react on sulphate of copper, and become the means of getting rid of the copper by association with the natural ingredients of the solids in the water. Consequently, there was no danger in using sulphate of copper in the minute quantities required in the presence of certain of the alkaline salts in the water.

Dr. Kemna, in replying to the discussion, said he had first to fulfil a duty by saying that the splendid drawings and photographs exhibited had been prepared for the meeting by his friend, Mr. Clemence, who was a water engineer, a very able microscopist, and a very able photographer. The second point was that water engineers must absolutely come to a clear understanding as to what microbes were. Everything that was in the water, and was not visible to the naked eye, was not necessarily a microbe. Coming to the remarks made upon his paper, Dr. Kemna said the question of the toxic effect of copper sulphate had been largely referred to. If one swallowed a handful of copper crystals, no doubt he would fare very badly indeed; but he would not be poisoned, because the substance was used as a vomitive. As to the use of sulphate of copper in a diluted solution, there had been a large quantity of literature on the subject, and very conflicting opinions had been held. Mr. Pickering had told them the question had been discussed at length in the last Bulletin issued by the Bureau of Washington. Of course, the general feeling was against drugging the water. Whatever they did to water, if they did not take it as it came naturally from the springs, they had always to work against feeling and custom. That was certain. In the last paper of the Bureau, they stated that they had underrated the difficulties arising from this feeling of the people; and so they had devoted a special memoir to going into these questions. He (Dr. Kemna) quite agreed with Dr. Thresh that the use of a small quantity of copper with such large dilutions, would do no harm. Moreover, the greater part of the copper was precipitated. They would not use the sulphate of copper for the pleasure of using it, nor for the pleasure of throwing it away, nor for making an

experiment upon their customers—they would only use it when it was necessary, when they had algæ which threatened to begin to multiply and give a lot of trouble in the reservoirs. This was the only occasion on which they must use sulphate of copper. If they had then at hand a substance which was not poisonous to their customers, and which could very efficiently deal with these extremely troublesome algæ, then they could safely use it. As to the taste and odours, which were bad and unpleasant, he did not think they were unhealthy. It had been asked whether sulphate of copper collected in the scum on the surface of the water; and one of the speakers remembered that he had read something to this effect. What he had read was that, after application of sulphate of copper to a reservoir highly charged with algæ, the scum collected at the surface, and could be skimmed off. It was not a precipitate of copper that formed the scum. It was the decaying plants which floated, and which concentrated a certain amount of the copper. A line had to be drawn between the organisms that were subjected to copper poisoning, and those that were not. It was one of the most interesting results of Naegeli, that diluted solutions would affect the lower organisms, but not the higher ones—both plants and animals. As to taste and odours, all were not due to algæ. There might be some sulphurous algæ at work at the bottom of a reservoir. He had been asked where the sulphate of copper was to be applied in such a case. That was very difficult to say. He could not possibly, on first notice, give opinions as to what should be done in connection with questions of detail, and when he had not even the slightest knowledge of the conditions of the particular reservoirs concerned, and, moreover, when not a single generic name of one of the possible organisms present was given. It had also been urged that the engineer must not take responsibility in this matter, but must be backed up by the chemist and the medical officer of health. He had not said anything to the contrary; and it was certain that the co-operation of these three individuals would be a very valuable proceeding, and very desirable and necessary. But what he had said was that the engineer must be able to get the requisite information from his foreman if the works were situated at a distance, unless there was a chemical man, a bacteriologist, or a botanist on the spot. But as things were, they would know there was something wrong when it was too late. They must have a man who was there daily and hourly; and he must use his eyes in watching what was going on, and call in expert aid when necessary. It had also been asked whether vegetable matter in the mains could be killed by sulphate of copper. Vegetable matter in the mains was a physiological impossibility, because vegetables could not live without light. What was in the mains was called moss; but they were always animals. Very likely the sulphate of copper would destroy them; but copper being precipitated by iron, the salt would not go far into the pipes. He was glad the discussion on the paper had not been merely a question of saying nice things about the author, but that there had been real discussion and real objections raised, and even a solemn entreaty had been made that the Association should not give its approval to the treating of water with a substance that was poisonous. The author of a paper spoke for himself only; and the Association as a body could not, and did not, take any responsibility.

(2)

LAYING A SUBMERGED WATER-MAIN IN THE RIVER SOUTH ESK, AT MONTROSE.

By HERBERT HALL,

Convener of the Montrose Water Committee.

Ten years ago, the author had occasion to resort to a submerged main; and he hopes that a description of it may be of interest to the Association.

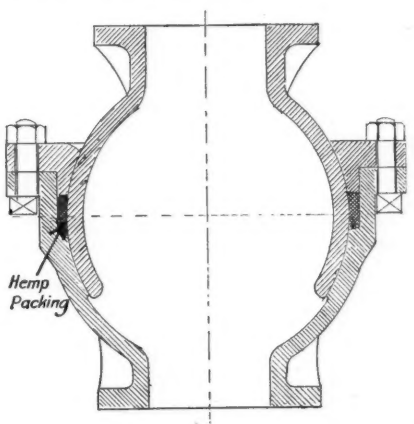
A portion of the Burgh of Montrose, known as Rossie Island, is separated from the mainland by the River South Esk. The island—about 40 acres in area—is connected with the burgh by means of a suspension bridge, 432 feet between the centres of the suspension piers. Running nearly parallel, but about 400 feet further to the west, is a railway viaduct, 1430 feet long, on the Montrose section of the North British Railway.

The River South Esk, where it runs through—or rather past—Montrose, connects the sea with a tidal-basin (known as the Montrose Basin). This tidal-basin has an area of about 1900 acres, and is filled and discharged at each tide for an average depth of 6 feet, which causes a powerful current, flowing alternately west and east, according as the basin fills or discharges. The current is stronger during the ebb-tide, on account of the discharge of the river being added to the contents of the basin; and the rate of flow during spring tides is from seven to nine miles per hour.

In 1895, the Town Council decided to give a water supply to the island by means of a 6-inch main. For some seven-and-a-half years previously it had been supplied in a meagre fashion, by a 1½-inch lead pipe laid upon the bed of the river. This gave considerable trouble, from its being caught by the anchors of fishing boats, and at other times from its being torn asunder by the strong outward current when accelerated by floods.

On negotiation, with the view of conveying it on the suspension bridge, the Bridge Committee objected to it on account of its weight; and the boxing-in, to protect it from frost, made it an obstacle in either of the narrow footways. The Railway Company demurred to having it on the viaduct which was only constructed for a single line.

Under these circumstances, it occurred to the author that, in the long run, it would be less costly to lay the main on the bed of the river. A wayleave was given by the Harbour Trustees, at a charge of 1s. per annum; and as the pipe when laid would be free from the effect of frost, it was thought that it might reasonably be expected to serve its purpose for a period of fifty years.



Detail of Ball-and-Socket Joint.

With an ordinary inland river, for a pipe of this size, probably no great difficulty—other than the irregular and rocky nature of the river-bed—would be encountered; but after careful consideration of the conditions of the River South Esk, the author decided to lay it from the surface of the river somewhat after the method of laying a cable, using ball-and-socket joints at every two lengths of pipe. This was done not only for the purpose of accommodating it to the irregular surface of the bed of the river, but to enable the main to be laid on a curve (in plan) to give freedom for any subsequent settling, and also to afford a thrust against the outward current. The position fixed upon at Montrose gave a length of 500 feet at the low-water level of ordinary neap tides.

The pipes (62 in number) were 6 inches in diameter, with flanged ends bracketted between the bolt holes; the average weight of each being 3 cwt. 2 qr. 2 lbs. The ball-and-socket joints (30 in number) were made as shown in the illustration. The connection of the pipes and joints was made by six bolts, ⅞-inch diameter, with a thin hard-rubber washer inserted between machined flanges.

The method of laying was by means of two barges securely anchored in the stream—one of them acting as a support while the leading one was used for bolting together the pipes and joints. The lowering was then effected partly by windlasses on the barges, and partly (in the deep parts) by the tide. The supporting barge was then re-anchored as a leading barge, and the operation repeated until completed. The work was done under contract by a Montrose firm, and successfully completed.

For the purpose of testing for leakage, which was done about every two months, the pipe was closed at each end of

the section by sluice-valves. On the inlet valve was a bye-pass with a ¾-inch Kent ("Absolute") meter indicating single gallons. The testing was generally done during the night, and the maximum leakage ever observed was 2 gallons in twelve hours—the longest period ever under test.

For the purpose of scouring, a 4-inch sluice-valve with a branch discharging into the river was fixed close to the outlet valve. All went well for seven-and-a-half years, when a leak was indicated which in three weeks assumed alarming proportions, and at a low spring tide was detected on the surface of the river. The harbour divers were requisitioned to examine it, when, to our consternation, they reported the existence of a hole due to the metal having been worn away by the action of the fine shingle upon it. The faulty pipe, however, was replaced at an expense of £40 by divers from Dundee Harbour, who on further examination reported it as badly worn for a length of twelve pipes. Three months afterwards it was again leaking in another position.

The only remedy was a renewal of this portion; and it was evident that to do it effectively meant relaying *de novo*, every seven years. The action of the ever-moving shingle was more than was bargained for; and with much reluctance the idea of a submerged main had to be abandoned. The author was fully of opinion that the weight of the pipe would have caused it to embed itself below the surface of the river bed out of harm's way; and this opinion was shared by others having considerable knowledge of the river. Unfortunately, it turned out otherwise, although in other respects the work was successful.

The cost was £270, made up as under:

62 Flanged pipes	£70	0	0
30 Ball-and-socket joints	142	0	0
Labour, &c.	58	0	0
	£270	0	0

The supply is now conveyed by copper pipes laid on the suspension bridge.

Discussion.

Mr. W. H. Humphreys (York) remarked that he understood that Mr. Hall was not a water engineer. Had he been, he (Mr. Humphreys) did not think he would have laid this 6-inch pipe in the manner described in the paper. He was afraid the author was too sanguine—after his experience with the 1½-inch lead pipe, which, he said, was always in danger of being cut by anchors, and had been torn asunder by the strong cross currents—to expect that a 6-inch pipe simply laid on the bed of the river, would last for fifty years. He (Mr. Humphreys) would have recommended a trench as necessary, if one could possibly have been made—more particularly as the bed of the river was so very uneven. In a trench, the pipe could have been laid straight across, and have been independent of the effects of the currents, and have lasted for many years. Laid in the manner in which the pipe was, no other result than that described by the author could be expected.

Mr. F. J. Bancroft (Hull) observed that about six years ago, he had to look into the question of laying an 18-inch gas-main and a 12-inch water-main under one of the Hull docks. He considered the alternatives of laying the pipes in the bottom of the dock, or constructing a subway under the dock. Ultimately, it was determined to construct a subway with two vertical shafts—one at each end. The vertical and horizontal portions were of a uniform diameter of 8 ft. 2 in., and formed of cast-iron segments. The work cost about £3000. It had been in every way satisfactory.

Imperial Measures for Engineering Work.—The British Weights and Measures Association, which has been formed with the object of defending, standardizing, and simplifying British weights and measures, have just had an important accession to their membership, by the placing upon the roll of the names of Messrs. Willans and Robinson, of Rugby. The object of the firm, as expressed in a letter to the Secretary (Mr. George Moores), is to assist in the fight the Association are making against the compulsory introduction of the metric system in this country. The system was adopted some time ago by the Company, with special reference to their Continental trade; but they are satisfied, after a long practical trial, that the advantages to be gained by its use in an English machine-shop are too dearly purchased. They say that for the last twenty years the thousandth part of an inch has been the unit for small measurements in their shops; and it has proved "a far more useful and practical decimal dimension" than any afforded by the metric system. The Association have a strong representative Committee.

LIGHTING OF RAILWAY PREMISES.

At the Meeting of the Institution of Mechanical Engineers on Friday, a paper on the above subject was read by Mr. Henry Fowler, of Derby, who is known to readers of the "Journal" from his connection with the Lighting Department of the Midland Railway Company, and his membership of the Midland Association. The chair was occupied by Mr. Hurry Riches, of Cardiff, Vice-President of the Institution. The following is an abstract of the paper.

The lighting on a railway is chiefly provided by means of oil, gas, or electricity; the choice of the agent used depending upon its availability and other circumstances. It may be generally assumed, however, that oil in ordinary lamps is only used at unimportant points, and where no other means are available. But some few years ago a system of vaporizing ordinary petroleum under pressure, and burning the resulting gas in a bunsen burner, was devised; and by this means a very powerful light is available at points where previously the lighting was a matter of difficulty, owing to their not being near a gas supply, and not being large enough to warrant the erection of an electric generating station. More recently there have been a number of more or less satisfactory petrol-lamps devised, in which the liquid is vaporized by the burner itself.

Gas is probably the most general illuminant, and has been able to maintain its position in the majority of places, owing to the introduction of Welsbach incandescent mantles. Several systems have recently been introduced of compressing the gas to allow of a better mixture of gas and air being obtained and a larger unit of light made available where necessary. Electricity was first chiefly used in arc lamps; and it has proved very satisfactory where a large area has had to be illuminated. But more recently, on railways as elsewhere, the need of a cheaper and smaller light has been felt; and this will doubtless be shortly supplied by some of the various types of lamps at present being perfected.

Although it may seem a truism, it is nevertheless a point frequently overlooked that illumination of an object is the ultimate goal of all classes of lights. This not only depends upon the the power of the light itself, but on the reflector, the colour and character of the surrounding substances, and the position of the object to be illuminated in relation to the light itself. Under most ordinary circumstances, the objects to be illuminated lie either on a horizontal or a vertical plane. On a railway proper, the station platforms are of the former type, and the station walls and the waggon sides and ends of the latter. It is now generally accepted that illumination should be expressed in terms of candles, or portions of a candle, at the distance of a foot; and to the unit of 1 candle at 1 foot has been given the name of a foot-candle. This being the case, the theoretical illumination of any point from a single unaided light can be readily obtained. The author has, however, for several years worked with a photometer which measures the total illumination on a horizontal plane with actual examples of lighting; and it is with the results of this work that he proposes to deal. The instrument is a development of the one devised by Messrs. Preece and Trotter, and improved by Mr. A. P. Trotter. The author is perfectly well aware that objection may be raised on the ground that this instrument is not an absolutely correct one. But it is the only one of its kind on the market; and he has found that in the same hands it gives comparable results. Another, and perhaps a more reliable, type of portable photometer is that of Messrs. Simmance and Abady, in which their "Flicker" photometer is used to obtain an absolutely definite reading. The principle of the flicker arrangement and its adaptation to this work have already been described.* It should, however, be pointed out that this is not an illumination photometer, and although adapted for giving a measure of the illumination from any one light, it cannot be used for general illumination on a vertical or a horizontal plane. The question of whether, in estimating the lighting required, the horizontal or the vertical illumination is to be considered, is dependent upon circumstances; and upon the decision arrived at depends the height at which the lamps should be fixed. As a general rule, the author has found that where the horizontal illumination is properly provided for, the vertical will be found to be satisfactory.

The space to be lighted in a station consists mainly of the platforms; and this necessitates the lights being placed in long lines down these platforms. The best position for these is nearly in the centre of the space to be lighted. Where there is a wall or building on one side, and the platform edge on the other, they should be slightly nearer the former, as the lamps are usually employed, in addition to their use for lighting purposes, as a means of denoting the name of the station. It is absolutely essential that the edge of the platform itself should be well defined. Height is a most important point, not only in station lighting, but in all other, as upon it depends the general character of the horizontal illumination. The ideal arrangement is to have a light of great intensity fixed at great height, when the illumination will be as even as possible. This, of course, is impracticable, and would lead to much loss of light, as only a small

* See "Journal," Vol. LXXXIV., pp. 22, 623.

portion of the spherical intensity would be utilized. In actual practice the distance the lights are apart has to be taken into account; and though Mr. Trotter has spoken in favour of the ratio of height to distance being as 1 : 3, in ordinary railway work the ratio for station lighting is usually not less than 1 : 5 or 1 : 6, and still the effect is good. The spherical intensity of a light has, of course, to be taken into account. Above all things, in lighting any space effectively, the fault of patchiness should be avoided. Nothing is more displeasing than to have any violent contrasts of illumination close together, and often a portion of a space looks badly lighted simply owing to its being compared with a much more brilliant patch near it. All variations of illumination should be as gradual as possible; and this is one of the chief reasons for surrounding arc lamps with opaque globes, which, though they retard a portion of the light, allow a better general effect by distributing the light more evenly. On a railway station, the lowness of the roof often prevents the lights being placed at the desired height; and in these cases the only satisfactory method is to use a number of small units close together, so that contrasts in illumination may not be too marked. Undoubtedly the best type of station to light satisfactorily is one with a large span roof, the sides of the buildings being of light-coloured glazed bricks. Various considerations, however, often prevent these being built; and then the precautions already mentioned should be taken in order to ensure satisfactory lighting.

Oil Lighting.—It is scarcely necessary to say that lighting by oil is only employed at small stations where no other form of illumination is available. It requires more attention than any other type; but at a small station this is not usually a matter of importance. The advantages of oil lighting are its simplicity, and the low cost per burner-hour for a light which, in many cases, is sufficient for the use to which it is put.

Many attempts have been made to use ordinary petroleum directly with incandescent mantles, but only with partial success, as special care is needed to keep the flame purely a bunsen one. There is, however, a highly successful lamp which vaporizes the petroleum, and uses the gas formed with an incandescent mantle. This is the Kitson light, which has now been used in England for about five years. The gas issues from the vaporizer at a high pressure, and the flame is very hot, with the result that the light given is intense. As a rule, two burners are fixed in each lamp, so that if one fails the other continues to give light. The average candle power of one of these lamps tested on a photometer-bar was 781 candles for a consumption of oil of 0·1135 gallon per hour. This works out at 8·3 grains per candle-hour, which is far in advance of any other type of lighting by means of oil. The cost of maintenance of these lights varies very much with their situation; and the following figures, which relate to lamps used in two exposed sidings for four years, are the only ones of which the author has personal experience, though at least one large station is lighted by such lamps in this country. Wages have been left out, as the installations mentioned consist of fourteen isolated lamps only; and this item would be much smaller per lamp if a larger number required attention.

Total number of lighting hours		54,989
Petroleum used, 3990 gallons	=	0·0726 gallon per lamp per hour burning.
Number of mantles used, 468	=	0·0085 mantle ,, ,, ,,
Gasoline used, 42 gallons	=	3 gallons per lamp per annum.
Repairs, renewals, small stores, &c., exclusive of wages, £14 8s. 1d.	=	20s. 6·93d. ,, ,,

From the candle power of these lamps it will be seen that they are only suitable for station lighting when they can be placed high up above the platform, unless a very strong light is required.

Acetylene Lighting.—Of the various other systems of lighting small stations, one of the most satisfactory is the use of acetylene. This is readily generated from calcium carbide, while most types of generators require very little attention. This has led to its adoption by many railway companies; but its expense has prevented its being generally used.

Carburetted Air.—Since the cheapening of the cost of petrol, consequent upon the greater demand for it for motor-car purposes, very many attempts have been made to use it for carburetting air for use with incandescent burners; the gas thus made to be used through ordinary gas-pipes to supply these burners. It need scarcely be said that special precautions require to be taken before the storage of even a small quantity of so inflammable a liquid as petrol can be allowed on a railway station; but arrangements can be made to render the risk of danger very slight indeed. Much ingenuity has been shown in the construction of air-gas plants, and several seem theoretically perfect; but the author has not come across one which has been tried practically with absolutely satisfactory results. In the case of one apparatus the author has experimented with, in which a portion of the gas made was used by a small hot-air engine for working the plant, a gallon of petrol gave 1240 cubic feet of gas which had a calorific value of 90·35 B.Th. U. When consumed in an incandescent burner, 9·45 feet per hour gave a light of 44·98 candles. The author believes there is a future for petrol-fed lamps, but the time for their general adoption has not yet come.

Gas Lighting.—Until a little more than ten years ago, except in a very few isolated cases, gas was the general illuminant for stations of any importance, and was almost universally used in an open or flat-flame burner. It need scarcely be said that the lighting was not only poor, but, by present experience, costly for the results obtained. Though this type of burner is becoming rapidly out of date on all stations where many trains are run at night, yet it still supplies the greater part of the lighting on several British lines. On every company's system there are a number of stations on branches, &c., where the trains are not run late in the evening, and where artificial light is only required for a short period each evening during a few of the winter months. In cases such as these, the flat-flame burner will probably continue to be used for some time, as the lighting required is not sufficient to make it worth while to employ incandescent burners, which, though much more efficient, require a certain amount for upkeep. It may be said that the difficulty might be overcome by only putting the incandescent burners on during the winter months; but it must be remembered the lights have to be available in cases of emergency at a moment's notice, and flat-flame burners allow of this with a minimum of trouble and expense. The burners most usually employed are No. 4 and No. 5, which, with 18-candle gas for a consumption of 4·9 and 5·3 cubic feet per hour, give on the photometer a light of 9·7 and 12·1 candles respectively. When employed on small stations, one of these burners is usually placed in each of the lamps, which are fixed from 50 to 60 feet apart; the burners being 9 ft. 6 in. above the platform level.

Regenerative Gas-Lamps.—Some years ago, Mr. F. Siemens introduced his regenerative gas-lamp, which, though requiring more attention, was a great advance on the flat-flame lamp in efficiency. This type of burner is still used on some stations, particularly as suspended lamps. One tested by the author gave 58·91 candles for a consumption of 7·65 cubic feet of gas per hour.

Incandescent Gas-Lamps.—The greatest stride in gas lighting was undoubtedly made when Dr. Auer von Welsbach devised his incandescent system. An ordinary "C" burner, using a gas giving about 700 B.Th.U. per foot, and consuming 3 feet per hour, can be depended upon for giving a light averaging 44 candles for 1000 hours. It would at first sight seem that the mantle was too frail to stand the vibration on railway premises; but experience shows that this is not the case. On the Midland Railway, there were in use on the 28th of June last, 48,392 incandescent burners; and though they are employed in all situations, the mantle consumption cannot be said to be high, as it only averaged 5·2 mantles per burner per annum. Under ordinary circumstances, with pillar lamps, where a good foundation for the pillar has been secured, and in nearly all cases with suspended lamps, it has not been found necessary to provide any type of anti-vibrating apparatus to preserve the mantles. When, however, a good foundation cannot be secured, and the vibration is excessive, the use of a simple apparatus, consisting of a frame suspended by a spring on which the burner is fixed, and to which gas is supplied by a rubber connection at the bottom, has been found advantageous.

It may not be out of place here to give the cost of maintenance of a "C" burner on the Midland line for one year to June last. The wages only will be given, leaving the cost of material to be filled in by anyone interested, from the figures available in his own particular case.

Mantles	5·20.
Chimneys	1·27
Forks	0·33
Wages	1s. 4·16d.

The wages may seem high; but it must be remembered that in many cases the burners in an incandescent burner attendant's district are scattered, and this amount also includes in some instances the cleaning of the lamp-cases and the time necessary to carry out small repairs, such as the renewal of glasses.

The author has so far only mentioned the ordinary "C" burner. He is aware that the various types of Kern burners, with their longer and better-designed mixing chambers for the gas and air, give a higher efficiency; but he has found that they require greater attention than those of the "C" type. On a photometer, the Kern burner will give more than 20 candles per cubic foot of gas burnt per hour; but he has not recommended its general use on the line. As will be readily understood, the number of burners inserted in a lamp, and the distance of the lamps apart, are matters to be considered in each particular case. Having a unit of light of about 50 candles (of which any multiple can be easily provided) allows of a very even lighting being obtained where necessary. As a rule, not more than three burners are grouped together for station lighting, though groups of five are used in special cases. With small stations, single burners, placed as with flat-flame lamps, about 60 feet apart, produce a good effect. Generally the lamps are spaced closer together under a station roof than in the open, for this latter is the portion of the station most in use. The distance between the lamps rarely exceeds 70 feet; and not often are they closer together than 40 feet; while the height of the mantle above the platform varies from 9 ft. 6 in. to about 14 feet.

As examples of the advantage of the adoption of incandescent gas-burners in place of flat-flame burners, the cases shown in the table next page may be taken.

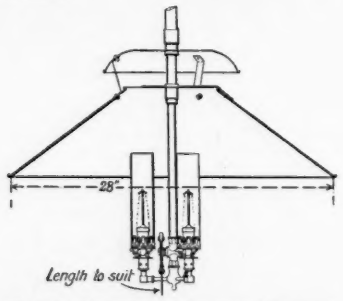
The cost of making the alteration was £41 10s. in case A and £36 10s. in B; and it will be seen that this will soon be wiped off by the saving shown, even after making allowance for the cost of maintaining the incandescent burners. It may be thought

—	A.		B.	
Flat-flame burners dispensed with.	130		134	
Total candle power of these. . .	1300		1340	
Incandescent burners fixed . . .	98		85	
Total candle power of these . . .	4336		3761	
Gas used per annum when flat-flame burners were employed	1,635,200 cub. ft.		2,015,700 cub. ft.	
Gas used per annum when incandescent burners were substituted	921,000 ,,		1,388,200 ,,	
Increase in candle power . . .	233 p. ct.		181 p. ct.	
Decrease in gas consumption . .	43·68 ,,		31·13 ,,	
	Total.	Per Burner.	Total.	Per Burner.
Maintenance of incandescent burners per annum—				
Mantles	414	4·220	750	8·82
Chimneys	90	0·920	104	1·22
Forks	20	0·204	16	0·19
Wages	£6 7s. 6d.	1s. 3·61d.	£4 5s. 8d.	1s. 0·1d.

that the mantle consumption varies too much at these two stations to be reliable; but they have purposely been selected to show good and bad examples, and represent two stations where the traffic, &c., varies.

High-Pressure Incandescent Gas.—Some few years ago, it was found that by using a much higher pressure, and allowing the air and gas to mix together in a longer chamber, better results were obtained. The pressure used was that of from 8 to 10 inches of water. The mantles are without chimney, and at a pressure of 10 inches of water give a light of 240·68 candles with a consumption of 10·18 cubic feet of gas per hour. The gas is raised to the required pressure by pumps which may be driven by water, a gas-engine, or an electric motor. In the earlier types of plant, water power was extensively used; but as the amount required varied from 188 to 327 gallons per 1000 cubic feet of gas compressed, this method was found to be in some cases expensive. More recently small gas-engines have been used; and in a plant which has been carried out under the charge of the author, the gas consumed by the engine has been only 20·8 cubic feet per 1000 cubic feet of gas compressed. This plant, which will consist of more than 300 burners when complete, is giving very good results, from a lighting and economical standpoint, with two-burner lamps placed 56 feet apart, and with mantles 13 feet above the platform. The lighting effect is very good, and free from patchiness. The mantle consumption of burners of this type is higher than with ordinary ones, and may, under railway conditions, be taken as from 8 to 10 mantles per annum. Several systems have been devised in which the pressure at which the gas is burnt is very much higher, rising in some cases to 54 inches of water. The result is a still greater efficiency per cubic foot; but the unit of light is raised higher than is usually required for railway purposes. One railway company employs one of these systems for dock lighting; while one of the best pieces of street lighting the author has seen—that of the Alexander Platz, Berlin—is with this type of burner.

Self-Intensified Burners.—The provision of high-pressure gas necessitates the laying of special mains, or at all events of having gas of a higher pressure in the mains than is usually the case. This has led to the invention of several types of lamps which are arranged to give the same effect independently, either by induced draught or by the provision of some mechanism in the head of the lamp for raising to about 30 inches of water the pressure of the air supply to the burner. Some of these types seem to work admirably; but the author has not had sufficient success with them to cause him to recommend their adoption extensively. This, however, may be due to local conditions. At all events, the results aimed at are those given in the figures mentioned with high-pressure lighting.



28-Inch Enamelled Reflector and Burners.

Interior Lighting.—The interior lighting on a station is, in the majority of places, confined to small rooms, with the result that the light is usually required at some particular spot, and consequently it is placed as near this point as possible. About the largest interior spaces requiring attention are parcel offices; and here it is found an illumination varying from 0·9 foot-candle on the floor gives good results. This can be obtained by three-light suspended "C" burners placed under an enamelled reflector. The illustration shows a 28-inch enamelled iron shade reflector, with a storm-cap to keep the burners free from dust, which has been found by the author a very efficient type of fitting. It is extensively used on the railway on which he is employed. Within the last year or two, the inverted type of burner has been much improved; and the smaller types supply a want in gas lighting, as they give an economical light of about 12 candles. The following are some results obtained with these burners on the photometer at an angle of 45 degrees:—

Burner.	Pressure.	Consumption of Gas per Hour.	Candle Power.	Candle Power per Cubic Foot per Hour.
	Inches.	Cubic Feet.		
A	1·8	2·805	77·510	27·63
B	1·0	1·430	25·370	17·74
C	1·0	2·290	50·540	20·06
D	1·5	1·525	24·964	16·37
E	3·0	2·990	84·310	28·20
F	3·0	1·015	27·540	27·13

Electric Lighting.—Electric lighting is at present (owing to the development of Nernst, mercury vapour lamps, &c.) somewhat in a state of transition; and the author proposes to confine his attention at present to the consideration of arc and incandescent lights only. He is anxious to admit that the latter type of lighting will probably before long occupy the place of the flat flame in gas lighting; but he believes that the new types of lamps have not as yet been generally adopted for railway lighting, though he knows that they are employed in several instances. In order that arc lighting may be used to the greatest advantage on a station, it is necessary, owing to the high unit of light given by the most satisfactory type of lamp, that it should be placed fairly high up—in fact, that the ratio of height of lamp to distance apart should not be greater than 1 : 4 or 1 : 5. One disadvantage of a very high light is the difficulty of attending to it in re-carboning, unless arrangements are made for dropping the lamp. The type of lamp usually employed is a 10-ampere 500-watt one. In some cases enclosed types of arcs, using, however, about the same amount of current, are employed. This type of lighting is particularly good when the space to be lighted is large, and when the height required for satisfactory illumination can be obtained. On the Midland Railway, several large stations are lighted in this way. With some railway companies, incandescent lamps are employed for lighting platforms on some of the smaller stations; but as a reliable lamp takes at least 3·5 watts per candle (or did at the time he prepared his paper), current must be cheap in order to make it at all economical. For interior station lighting it is much more satisfactory, as in many cases an 8-candle lamp over a desk is all that is required; and the small "Bijou" incandescent gas-lamp is the only thing which can compete with this.

Goods Yards and Sidings.—In lighting these places, as distinct from goods sheds, two conditions may obtain. It may be that it is necessary to provide for lighting a space, as, for instance, the entrance of a yard, or a particular point, such as a capstan. On these considerations, the type of light used will depend. In the first case, high-power lights are wanted, and they should be placed high, so as to distribute the light; in the second case, a smaller light at the point required is all that is necessary. For the lighting of the yards themselves, three-light incandescent gas-lamps, about 80 to 100 feet apart, or arc lamps about 100 to 120 feet apart, afford sufficient illumination under ordinary conditions. It frequently happens, however, that the necessity for providing light at some particular point—such as a crane, capstan, crossing, &c.—causes the lamps to be placed much closer together. In small yards, where neither electricity nor gas is available, "Veritas" oil-lamps in suitable cases may be used. The conditions vary so much that illumination curves of lighting of this description are not of much value; but from a number of readings the author has taken, he thinks that if the light provided does not sink below 0·05 foot-candle at the ground level, it will meet any case. In the lighting of sidings, a combination of horizontal and vertical illumination is required; and if a single pair of points has to be dealt with, a light of not too high power (say, 100 candles), placed at not too great a height, is all that is needed. Where several sidings run one after another into a shunting road and a line of lights is provided, three-light incandescent gas-lamps, 100 feet apart, or arc lamps on high posts, and spaced a greater distance, will be found satisfactory. In some cases special lighting has to be provided; and as a case in point the author would quote gravitation sidings such as now exist on most railways. Here the number of the road the waggon is to go on is chalked on the end of the waggon before it is "cut" from the train and started down the incline. It is necessary that this number should be easily read; and in order that this may be done, the author has found that three-light incandescent lamps, with reflectors behind the mantles, on fairly low posts, answer this purpose admirably. At points where trains are broken up on these sidings, a particularly good light is required; and a minimum illumination of 0·15 foot-candle is not any too much. In sidings where neither gas nor electricity is available, the Kitson high-pressure oil-lamp will be found very useful.

Goods Sheds.—Here, even more than on stations, the points available for fixing lights are very confined. An ordinary shed

consists of stages with cranes, with a cartway on one side and a siding on the other. The cartway is often so wide as to require some light down it; and this is provided by a line of lamps placed at sufficient height to prevent damage from high loads. On the stages a good light is essential, owing to the necessity of reading labels quickly and easily. With gas lighting, groups of two or three incandescent burners in lamps placed from 30 to 40 feet apart, and from 11 to 13 feet above the platform, are found to give a satisfactory light; the illumination—neglecting the portion directly under the lamp—varying from 0·9 to 0·25 foot-candle. Where arc lighting is used in these sheds, the lights are usually placed from 45 to 60 feet apart, and at heights from 13 to 15 feet above the stage level. The illumination varies from 2·25 foot-candles down to 0·4 foot-candle.

Locomotive Sheds.—The sheds of the Midland Railway Company are of two types, either square ("round") with a turntable in the centre and pits radiating from it, or rectangular, with an entrance at one end and pits running down the length of the shed. The lighting was formerly carried out by means of star or similar gas-lights, with 4, 6, or 8 burners, each consuming about 5 cubic feet per hour. In the case of the "round" sheds, the lights were placed between every alternate pit, with the result that one side of each engine was left in darkness. On the advent of the incandescent burner, the old lights were replaced by two-light incandescents, either in lamps or under shades, placed between each pit. The result was that not only was a better and more evenly distributed light obtained, but considerable economy was effected in the cost of lighting. With the rectangular sheds, the lights usually required re-arranging; but the improvement effected in lighting and the economy realized were the same. The percentage of saving is rather hard to give from actual figures, as the gas consumption in the sheds themselves is not measured; the gas-meters provided also registering the gas used in the yard, shops, offices, &c. The following figures, however, may be interesting, as showing the economy effected on the whole by the substitution of incandescent burners for some of the flat-flame ones in use. The figures given under "C" are for the "round" engine-shed already referred to, and apply to two adjacent sheds, &c., controlled by one meter; those under "D" are for the rectangular shed.

—	C.		D.	
Flat-flame burners dispensed with.	539		273	
Total candle power of these.	5,390		2,730	
Incandescent burners fixed	266		141	
Total candle power of these.	11,770		6,239	
Gas used per annum when flat-flame burners were employed.	6,947,800 cub. ft.		4,000,500 cub. ft.	
Gas used per annum after incandescent burners were employed	4,452,500 cub. ft.		2,354,000 cub. ft.	
Increase in candle power	118 p. ct.		128 p. ct.	
Decrease in gas consumption	35·9 ,,		41·16 ,,	
	Total.	Per Burner.	Total.	Per Burner.
Maintenance of incandescent burners per annum—				
Mantles	1692	6·36	1076	7·63
Chimneys	346	1·3	322	2·28
Forks	152	0·57	130	0·92
Wages	£26	1/11·46d.	£13 13s.	1/11·23d.

The cost of making the alteration was £376 in case C, and £146 in case D; but it will be seen that these amounts were very soon wiped off by the saving effected, even after allowance had been made for the cost of maintaining the incandescent burners.

Lighting of Workshops.—With the exception of the shops in which the locomotives or carriages themselves are erected or repaired, the general conditions and arrangements in railway works are very similar to those found in any engineering works. In 1893, Sir (then Mr.) Benjamin A. Dobson read an interesting paper on "The Artificial Lighting of Workshops," in which special reference was made to the use of inverted arc lamps placed under large whitewashed reflectors. This class of lighting is particularly effective in many cases; but as it was so fully dealt with at the time, the author does not propose to refer to it.

Lighting of Locomotive Erecting Shops.—In lighting a locomotive erecting-shop, certain initial difficulties are met with. These are the need of a good general well-diffused light, and the fact that, as cranes run down the whole width and length of the shops, the light must be at least 29 feet above the level of the floor. The author was met with these difficulties when asked to improve the illumination of a large erecting-shop of three bays, each measuring 450 feet by 50 feet. At first arc lamps, under large whitewashed reflecting boards, were tried above the cranes; but, for one reason or another, they were not wholly satisfactory. These lamps were then superseded by arcs placed between the columns separating the bays. But this did not provide a sufficient light in the centre of the shop. About this time a smaller shop was erected at Kentish Town; and the author lighted it by high-pressure gas-burners, placing three of these under a whitewashed reflector. The results are very satisfactory—a steady well-diffused light being obtained, while the burners have required little attention, and the consumption of mantles has been low. In this case, as so small a number of burners are used, water is employed for raising the gas pressure from 1 inch to 8 inches; and as an old-type compressor was fixed, the water consumption has been somewhat high—being 327 gallons per 1000 cubic feet of gas compressed.

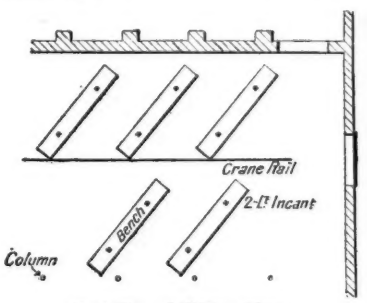
The burners are 30 ft. 6 in. from the floor, on which the illumination varies from 0·48 to 0·95 foot-candle. The success of this lighting led to the same system being adopted at the large shop previously mentioned. The illumination 29 ft. 8 in. below the burners varies from 0·8 to 1·4 foot-candle. It is found that the burners only require attention about every seven to ten days. The cost of maintenance, in addition to that of gas (each burner consumes about 10 cubic feet per hour), has been as follows for the year to June last:—

Mantles	2·85
Forks	0·23
Sundry fittings, &c.	4·55
Wages	6·00d.

The lights are, of course, only used during the dark months, or when special work has to be carried out during the night.

Brass Foundry.—The satisfaction given by this lighting, and the economy attending it, have led to its being adopted in all shops where a good general light is required—such as those in which boilers, tenders, &c., are dealt with. It has even been installed in the brass foundry at Derby, and has been found very satisfactory. The height the burners are fixed above the floor (21 feet in this case) is apparently sufficient to prevent their being interfered with by the dust, &c., which is always found in such shops.

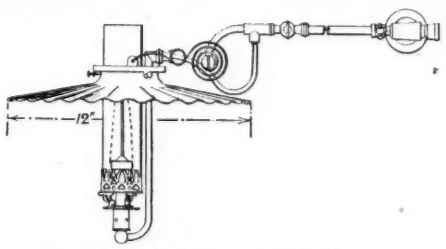
Fitting Shops.—In fitting and machine shops, though a general light is required, particular points need special attention unless the general illumination is very good. In the discussion on Sir B. A. Dobson's paper, already mentioned, Mr. J. A. F. Aspinall showed by photographs, &c., the success achieved by fixing arc lamps under large whitewashed screens in the fitting-shop at Horwich. The construction of this building has allowed of the systematic arrangement of a large number of arc lamps; and the author, who has worked both on machines and at the bench in this shop, can testify to the excellent effect given. In the shops he has had to deal with, the construction has not admitted of the employment of large units of light, as in order to use them successfully they must be placed at a considerable height above the surface to be illuminated, and in somewhat awkward positions. With gas available at very low cost, extensive use has been made of the two-light incandescent gas-fitting under a 28-inch enamelled shade already referred to. The use of a smaller unit of light such as this allows of a much better illumination when the lights have to be fixed lower down.



Part Plan of Fitting-Shop.

An example of the lighting of a series of fitters' benches in this manner is shown in the accompanying diagram. The illumination on the benches in this instance is more than 2·25 foot-candles. In such cases as these, no type of anti-vibrator has been found necessary, as the mantle consumption is not heavy.

In some cases, owing to the provision of cranes, or from other causes, it has been found necessary to provide a special light for a vice. In such positions, a single light with a special anti-vibrator, shown in the illustration below, has proved useful. These have



Bench Light, with Anti-Vibrator.

also been employed to light a row of lathes fixed against a wall, and where it was not thought advisable to provide large units of light high up. In these circumstances, they are fixed to the wall behind the lathe.

Paint and Carriage Shops.—In both locomotive and carriage paint-shops, not only is a good light required, but it has to be provided in long rows to illuminate thoroughly the vehicles on each side. In dealing with these cases, the two-light incandescent

fitting previously mentioned has been found very successful. [As an example of the saving effected by incandescent over flat-flame lighting with gas, the author gave two curves—one showing the lighting by groups of four-light flat-flame burners, using 24 feet of gas per group; the other the improved lighting provided by two-group incandescent gas-lights, with a consumption of 8 feet per hour, or only 33⅓ per cent. of the amount used with the former lighting.] In the lighting of carriage-shops generally, the same conditions occur as are found in paint-shops. These prevent the provision of high units of light, especially as the shops are of necessity not so high as locomotive erecting shops, as cranes are not often used. The same system of lighting has been adopted as with the paint-shop.

Iron Foundry.—The lighting of iron foundries seems to be one particularly suited to arc lamps; but the author from his experience with high-pressure gas-lights in the brass foundry referred to, believes that this system of gas lighting may be employed successfully in illuminating what is usually the one dark spot about a works. At Derby, the side of the foundry on which light work is carried out, and along which no crane runs, has been lighted for some time past with ordinary incandescent gas-burners. On the section where a crane is necessary to deal with heavy castings, &c., high-pressure gas-lights under whitewashed reflectors have been installed. In this connection, it may not be out of place to refer to the very strong influence of dark walls, floor, &c. The floor of a foundry is never in any sense a reflector; while the dust which settles on, at all events, the lower parts of the walls, prevents them doing their part in the general illumination. The question of the colour of surroundings on lighting effect, though often referred to, is too often neglected. In some figures given in a short paper read by the author before the Manchester District Institution of Gas Engineers in 1902,* he showed that this in practice may add about 20 per cent. to the actual illumination.

In conclusion, the author pointed out that if he had seemed to deal with the question of gas lighting somewhat to the exclusion of other types, it was because he had of necessity had to speak of the lighting he had had most to do with. He expressed his indebtedness to Mr. R. M. Deeley, for his kindness in granting him permission to write the paper, and to use the figures quoted; and to his Assistants (Messrs. Donne, Caton, and Burgess) for the help they had rendered him in preparing it.

Discussion.

The CHAIRMAN said he had great pleasure in proposing that a hearty vote of thanks be accorded to Mr. Fowler for his interesting paper. He asked them to pass this before proceeding to the discussion.

The vote having been carried by acclamation,

Mr. A. P. TROTTER, Electrical Adviser to the Board of Trade, remarked that the most important part of the paper was undoubtedly the economic one; and this was the portion on which he (the speaker) was quite unable to contribute to the discussion. It would certainly have been very useful if the author could have placed before them some tabular statement as to the comparative costs of different lighting—for example, the number of candle-power-hours one could get for a penny. It would then be found, he thought, that oil would be the most expensive kind, and the arc light the cheapest; and the most expensive sort of lighting was used at the smallest countryside stations. When lighting was compared by candle-power-hours for a penny, it was a question of the ordinary bar photometer; but it was easy to see that this alone would be no good for the engineer who required to light various premises. Here the question of distribution was of the highest importance, as affecting the amount of light in different places; and this matter had been carefully dealt with in the paper. It would be impossible to discuss all the details as he should like to do; and he would only touch upon one or two small points. The author spoke of vertical illumination. No doubt he meant illumination on the vertical plane; and he (the speaker) thought he was quite right in saying that if the lighting on the horizontal plane was attended to, the vertical plane would look after itself. But, at the same time, he did not say anything about height. In connection with the work which he (the speaker) did some years ago, he took the light as near the floor as possible; but other people lately had worked at about 4 feet from the ground, which made a considerable difference. Then the author said: "Above all things, in lighting any space effectively, the fault of patchiness should be avoided." This was so in most of the examples that had been mentioned; but he thought it was not the case with street lighting. In economical lighting of the streets, he believed patchiness was a good thing. A street was better lighted with a certain amount of patchiness; and this was an exception that should have been made. As to the "Trotter portable photometer" referred to by the author, he must confess that when first he opened the paper he was a little bit surprised to see this, because he had never had any opinion at all of the photometer. It was very kind to put his (Mr. Trotter's) name to it; but in reality it was designed after he had left England for South Africa. There were several defects in it—in the first place, the Hefner lamp, which he regarded as most unsuitable for outdoor work. He was, however, now quite converted; for he saw that the author had done most excellent work with it. He might say that he did not think he had ever seen one of the photometers; but he had with him one on somewhat similar lines, which he had made as a hobby, and which he had brought for the inspection of the members.

Mr. WILLIAMS, of the Great Western Railway, said Mr. Fowler, with his characteristic modesty, had not touched on his labours in converting the flat-flame burners on the Midland Railway to the incandescent system; but it meant practically re-organizing the lighting of every station, depôt, goods shed, yard, and all parts of the Company's premises. They had had the same sort of job in connection with the gas lighting on the Great Western line; and it had been very arduous work. It had, however, certainly saved 30 per cent. on the lighting bill, which was rather a large matter. They had to thank Mr. Fowler, for he was a year or two ahead of the Great Western. He did not, however, have quite so much to do as his (the speaker's) Company, because his lamps were more modern to start with. The Great Western had now put up some inverted burners; and they had lamps that would give 40-candle power, with a consumption of 3¼ cubic feet of gas per hour. No doubt, for big depôts, electricity was the thing; but gas held its own—especially with high pressure. Mr. Fowler suggested three burners in his yard lamps; but his (the speaker's) Company could do with two.

Mr. J. E. EVERED, representing the Kitson lamp, remarked that the author referred to the lamp, but did not give any account of the upkeep cost, inclusive of labour. He brought out the cost per annum, exclusive of wages, at 20s. 6·93d., which worked out at 0·494d. per lamp-hour; but Mr. Fowler mentioned in the paper that for a larger installation the cost would be considerably less. In proof of this, he (the speaker) might point to the large installation there was at Sunderland Station. There there were 33 lamps running; and the lamp-hour worked out, inclusive of labour, at 0·75d. This figure, he might mention, he had obtained from the Chief Engineer of the Northern Division of the North Eastern Railway. Later on the author referred to a system of lighting by means of reflectors fitted in the roof. He (the speaker) had experience of lighting large shops and foundries where there was employed a jib-crane, about 10 feet long, which was made to swing easily, and at the end of which the lamp was suspended. When the crane chains touched it, it merely swung to one side. In this way, they could put a lamp 9 or 10 feet from the floor, instead of about 30 feet. This was a very great help to illumination in such places as foundries, where steam and thick smoke obscured the lighting very much.

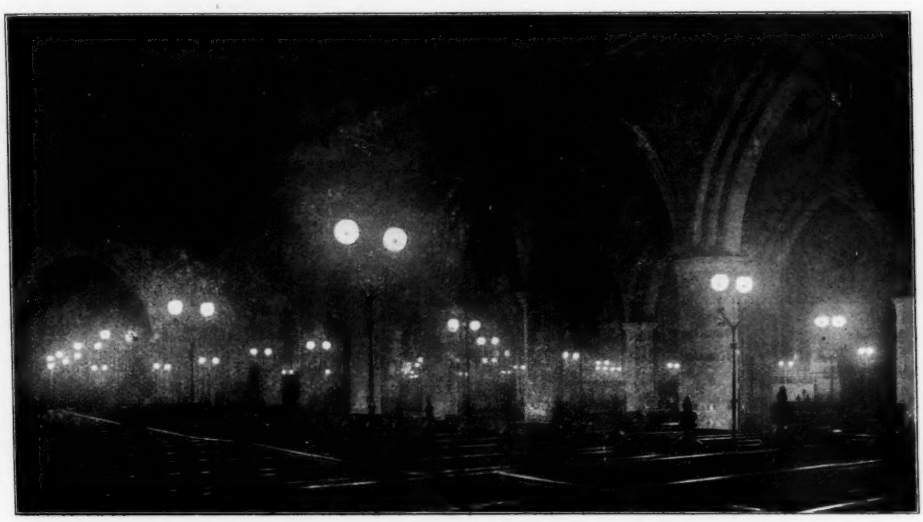
Mr. ROGER T. SMITH said there were two sorts of illumination which people who provided light measured nowadays—lighting in streets, and lighting for such purposes as were discussed in this paper—and he thought they were quite different. As Mr. Trotter had pointed out, they required patchy lighting in streets; and therefore it was more important perhaps to measure candle power than illumination. One wanted illumination for nearly all railway purposes; and so it was the illumination that ought to be measured. He really thought the instrument referred to allowed of this being done. The illumination curves obtained by its aid could be very easily measured; and if a station or goods yard gave satisfactory results, the traffic or the goods department would say: "Light me a yard or station just like that." The amount of illumination could be very easily measured, the position of the lights to produce that illumination was readily calculated, and it then became merely a question of knowing what was the cost of electricity and gas to determine, on the data arrived at, which was the proper illuminant to use for that particular place. The author had mentioned that his reference to electric lighting was not very extensive, and had invited discussion on this part of the question. He should just like to allude to the use of flame arcs. It was a matter of modern development; and the great difficulty at present was to get a satisfactory flame arc lamp (which for the same expenditure of energy gave very much more light than the ordinary arc) that would burn more than ten or twelve hours. When this difficulty was overcome, he thought the flame arc lamp—both for colour and cheapness—would provide an illuminant which would be of very great value for railway purposes. He might perhaps mention that Paddington Station had been lit by arc lights for twenty years; and though nothing now existed of the riginal lamps except their cases (all the interior parts having been emoved in the process of maintenance), they were still the same orm of lamp as at first. They were, however, about to replace these by flame arcs, with which five times as much light would be obtained with the same expenditure of energy.

At this point, the discussion was adjourned until the next meeting.

* See "JOURNAL," Vol. LXXX., p. 1541.

The Trials of Suction-Gas Plants at Derby.—Readers may remember that at the meeting of the Royal Agricultural Society of England at Derby last June, some trials of suction-gas producers and engines suitable for agricultural purposes were carried out. The report on the trials, by Captain H. Riall Sankey, R.E., M.Inst.C.E., was presented at the meeting of the Society last Wednesday, and has since been published. As already announced in the "JOURNAL," the Judges awarded a gold medal to the National Gas-Engine Company, Limited, for their 20 B.H.P. plant; and a silver medal to Messrs. Crossley Bros., Limited, for theirs of 15 B.H.P. It is considered probable that suction-gas plants will be able to replace portable steam-engines for many purposes with distinct advantages, both as regards handiness and economy. We shall notice the report more fully next week.

INCANDESCENT GAS LIGHTING OF YARMOUTH PARISH CHURCH.



Gas Lighting in Yarmouth Parish Church.

In the "JOURNAL" for the 28th of August, we quoted from a local paper some appreciative remarks as to the improvement which was then being effected in the lighting of the Parish Church at Great Yarmouth, by the substitution of the incandescent gas system for the flat-flame burners previously in use. The work was placed in the hands of the Gas Company, and it has now been completed under the personal supervision of Mr. Charles Ellis, the Superintendent of the Distributing Department. The church is the largest in the United Kingdom, measuring 230 feet in length, 110 feet in breadth, and 148 feet across the transepts, and though the neighbouring cathedral at Norwich, which owes its existence to the same founder (Bishop Herbert de Losinga) exceeds it in total length by about 180 feet, it is only 72 feet in breadth, while the measurement across the transept is but 30 feet more than the church. It will be seen, therefore, that Mr. Ellis had an unusually large interior—an area of no less than 23,265 square feet to deal with; and some idea may be formed from the accompanying photograph as to the effect of his labours. As mentioned in the August issue, the standards, which have been cleaned, lacquered, re-polished, and re-arranged, have four branches, two of which carry incandescent burners, and the others flat-flame burners to be used as auxiliaries. The incandescent burners are No. 4 Welsbach Kern, fitted with anti-vibrators, and enclosed in obscured globes. There are altogether 110 of them, and they take the place of about 300 flat-flame burners consuming, on an average, 6 cubic feet of gas per burner. Their combined illuminating power is upwards of 10,000 candles with a greatly reduced consumption of gas. We have not had an opportunity of judging of the effect, but we learn from a local paper that the light produced is a "beautifully soft and restful one," that the manner in which it is modified at times during the service is most satisfactory, and that the Church Council are very pleased with the result. As renovated standards add considerably to the general appearance, it should be mentioned that the lacquering and re-polishing of them was entrusted to Messrs. D. Hulett and Co., whose prompt attention greatly facilitated the carrying out of the work. It only remains to say that the photograph reproduced was the result of an exposure of only four minutes, owing to the intensity of the light. The grand old church of St. Nicholas, Great Yarmouth, which has a life-history of about 800 years, may now claim to be not only one of the largest, but also one of the best lighted of our English parish churches; and all who have been associated with the latest improvement in the fabric—the Church Council for initiating it, and Mr. Ellis and Messrs. Hulett for so effectively carrying it out—are to be heartily congratulated upon the outcome of their combined efforts.

THE EFFICIENCY OF HEATING APPLIANCES.

(*Concluded from p.* 460).

V.—THE EFFECT OF USING STEAM.

In this portion of his article, Dr. Geipert also carries out all his calculations with and without allowance for the variations in the specific heats. He works out the results in the two ways, (*a*) in the absence of steam, (*b*) when 0·255 kilo. of water is used per kilo. of coke, and (*c*) when the consumption of water reaches 0·567 kilo., both when the secondary air is heated to 800° and when it is heated to 1000° C. The general results are recorded in the table given below; but the methods of calculating upon variable specific heats when the secondary air is heated to 1000° C., and when the consumption of steam is either *nil* or 0·567 kilo. per kilo. of coke, may be indicated.

(1) *In the Absence of Steam.*—The formation of 1 cubic metre of CO evolves 1295 Calories, and the gas is mixed with 1·88 cubic metres of N_2, so that the total volume is 2·88 cubic metres. The temperature of the producer gas is therefore $\frac{1295}{2{\cdot}88 \times 0{\cdot}34} = 1323°$ C. In the furnace it is burnt with a quantity of secondary air equal in volume to the primary supply—viz., 2·88 − 0·5 = 2·38 cubic metres. The waste gases may contain 21 per cent. of CO_2, and they leave the furnace at 1000° C. They therefore contain per cubic metre of CO 1000 × (0·55 + 1·88 × 2 × 0·33) = 1790 Calories. The heating of the secondary air recovers 2·38 × 1000 × 0·33 = 785 Calories; so that 1005 Calories or $\frac{1005}{4341} \times 100 = 23{\cdot}2$ per cent. of the heating value of the coke is lost. By the regeneration the temperature of the waste gases falls to $1000 - \frac{785}{4{\cdot}76 \times 0{\cdot}41} = 597°$ C. If the heat equivalent to this temperature is employed to raise the temperature of the primary air to 538° C., a further amount of 597 × 2·38 × 0·32 = 455 Calories is recovered; and the final loss of heat then becomes only 1005 − 455 = 550 Calories, or $\frac{550}{4341} \times 100 = 12{\cdot}7$ per cent. of the heating value of the coke. In this case the temperature of the waste gases is $1000 - \frac{785 + 455}{4{\cdot}76 \times 0{\cdot}39} = 332°$ C.

(2) *In the Presence of Steam.*—If 0·567 kilo. of water is employed per kilo. of coke, the producer gas has the composition: CO, 1·0; H_2, 0·378; N_2, 1·17 (total 2·548) cubic metres. The requisite volume of primary air is $\frac{1 - 0{\cdot}378}{2} = 1{\cdot}48$ cubic metres, and that of the secondary air $\frac{1{\cdot}318}{2} \times \frac{100}{21} = 3{\cdot}28$ cubic metres. The furnace gas consists of CO_2, 1·0; H_2O, 0·378; N_2, 3·76 (total 5·138) cubic metres. Being at a temperature of 1000° C., it contains (0·545 + 0·378 × 0·49 + 3·76 × 0·33) × 1000 = 1971 Calories, of which the secondary air takes up 3·28 × 0·33 × 1000 = 1082 Calories, leaving a loss of 889 Calories, equal to $\frac{889}{4341} \times 100 = 20{\cdot}5$ per cent. of the heating value of the coke. During the regeneration the temperature of the waste gases falls to

$$1000 - \frac{1082}{1 \times 0{\cdot}63 + 0{\cdot}378 \times 0{\cdot}56 + 3{\cdot}76 \times 0{\cdot}35} = 499° \text{ C.}$$

If the primary air and the steam are raised to that temperature by further regeneration, they absorb as sensible heat 499 × (1·48 × 0·32 + 0·378 × 0·42) = 315 Calories, and the steam takes up (by the vaporization of 0·378 × 0·804 kilo. of water) 0·378 × 0·804 × 600 = 182 Calories. Hence a further 497 Calories are recovered, and the waste gases fall to a temperature of

$$1000 - \frac{1082 + 497}{1 \times 0{\cdot}58 + 0{\cdot}378 \times 0{\cdot}52 + 3{\cdot}76 \times 0{\cdot}337} = 226° \text{ C.}$$

The final loss of heat is then 1971 − (1082 + 315) = 574 Calories

or $\frac{574}{4341} \times 100 = 13{\cdot}2$ per cent. of the heating value of the coke.

The heat developed in the producer is: Formation of CO = 1295 Calories, introduced by the primary air and steam 315 Calories, total 1610 Calories, from which must be deducted the heat absorbed in decomposing 0·378 cubic metre of water vapour—viz., 983 Calories. The net heat developed is thus 627 Calories. Therefore the temperature is

$$\frac{627}{2{\cdot}548 \times 0{\cdot}32} = 769^\circ \text{ C.}$$

The results in other conditions are given by the following table, where the figures in *italics* refer to calculations made with variable specific heats:—

—	Steam Used per Kilo. of Coke.		
	0·0	0·253.	0·567.
I. Cold Primary Air:			
Temperature in producer . .	1450°	1000°	
	1323°		
Loss in waste gases, secondary air at 1000°	19·8 p. ct.	18·4 p. ct.	16·7 p. ct.
	23·2 ,,		*20·5* ,,
Secondary air at 800° . . .	23·2 ,,	22·3 ,,	21·4 ,,
	26·8 ,,		*25·5* ,,
II. Hot Primary Air:			
(*a*) *Hot Steam.* Loss in waste gases, secondary air 1000° .	10·6 ,,	10·9 ,,	10·9 ,,
	12·7 ,,		*13·2* ,,
Secondary air at 800° . . .	14·0 ,,	14·9 ,,	15·6 ,,
	16·3 ,,		*18·2* ,,
(*b*) *Cold Steam.* Lost in waste gases, secondary air at 1000°	10·6 ,,	11·6 ,,	12·3 ,,
	12·7 ,,		*15·0* ,,
Secondary air at 800° . . .	14·0 ,,	15·6 ,,	17·0 ,,
	16·3 ,,		*20·0* ,,

Hence it is manifest that, if the regenerating plant is built properly, an introduction of steam in quantity suited to the temperature conditions in the producer is in all circumstances advantageous when only the secondary air is preheated, owing to the effect it produces upon the relative volumes of primary and secondary air required. If the primary air is also preheated, the use of steam is disadvantageous in the above-mentioned respect; but the evil effect is so trifling that it is certainly outweighed by the smaller loss of heat by radiation from a producer kept cooler than it otherwise would be through the introduction of steam. The conclusion that the employment of steam is always beneficial, corroborates what Bunte has said on former occasions.

Still using Le Chatelier's corrected specific heats for high temperatures, the quantity of steam (x) which may be introduced into the producer without causing its temperature to fall below 1000° C. is calculated thus from the data already given—

$$\frac{1295 - x \times 2600}{2{\cdot}88 \times 0{\cdot}33 - x\,\frac{79}{42} \times 0{\cdot}33 + x \times 0{\cdot}33} = 1000;$$

whence $x = 0{\cdot}144$ cubic metre of water-vapour per 1 cubic metre of CO, or 0·216 kilo. of water per 1 kilo. of carbon. In this case, the producer gas amounts to 2·754 cubic metres, and contains 1 cubic metre of CO, 0·144 of H_2, and 1·61 of N_2. Hence t becomes

$$\frac{1295 - 0{\cdot}144 \times 2600}{2{\cdot}754 \times 0{\cdot}33} = \text{(about) } 1000^\circ \text{ C.}$$

VI.—Mechanism of Water-Gas Manufacture.

It is supposed that the producer contains 1000 kilos. of coke (composed of pure carbon) at a temperature of 1000° C., which is raised to 1250° by the air blast; pure CO_2 only being evolved. During the run, the temperature falls to 1000° again. The waste gases contain 19 per cent. of CO_2; and their average temperature is 1125° C. Loss of heat by conduction and radiation is ignored. The amount of heat absorbed in heating the coke from 0° to 1250° (using a new factor given by Le Chatelier) is $1253 \times 1000 \times 0{\cdot}38 = 475{,}000$ Calories. Deducting the heat required in raising it to 1000°—viz., $1000 \times 1000 \times 0{\cdot}363 = 363{,}000$—there remain 112,000 Calories for the heating between 1000° and 1250°. This heat is employed in heating and decomposing the steam. The waste gases carry away with them as sensible heat $1125 \times 0{\cdot}378 = 425$ Calories per cubic metre; but as they contain 19 per cent. of CO_2 (or 0·1018 kilo. of C per cubic metre), they have evolved $0{\cdot}19 \times 4341 = 825$ Calories per cubic metre. Hence the heating of the coke per 1 cubic metre of waste gas, or per 0·1018 kilo of C, from 1000° to 1250° requires $825 - 425 = 400$ Calories. The above quantity of 122,000 Calories therefore suffices to heat $\frac{112{,}000 \times 0{\cdot}1018}{400} = 28{\cdot}5$ kilos. of coke. The three reactions of water-gas manufacture develop (absorb) the following quantities of heat in Calories at the temperatures quoted:—

	$H_2 + O = H_2O$	$C + O = CO$	$H_2O + C = CO + H_2$
0° C. . .	2600	1295	—
1000° C. . .	2607	1324	− 1283
1125° C. . .	2598	1331	− 1267
1200° C. . .	2587	1335	− 1252
2000° C. . .	2436	1387	− 1049
3000° C. . .	2087	1427	− 660

Thus, in the case under consideration, decomposition of the steam absorbs 1267 Calories. To raise the steam from 100° C. to 1125° C., $1025 \times 0{\cdot}52 = 533$ Calories are required; the total being accordingly 1800 Calories. Therefore the 112,000 Calories mentioned are sufficient to heat and decompose $\frac{112{,}000}{1800} = 62{\cdot}2$ cubic metres of dry steam at an original temperature of 100° C.

The waste gases from 28·5 kilos. of coke measure $\frac{28{\cdot}5}{0{\cdot}1018} = 280$ cubic metres, and contain $280 \times 1125 \times 0{\cdot}378 = 119{,}070$ Calories. If this amount, *plus* the quantity of 112,000 Calories already mentioned, could be wholly transferred to the steam, a total of 231,070 Calories would be utilized. Now, the heat absorbed in converting 0·804 kilo. of water at 0° C. into 1 cubic metre of steam at 100° is $(536 + 100) \times 0{\cdot}804 = 511$ Calories; that required to raise it to 1125° is 533 Calories; and that required to decompose it [see above] is 1267 Calories. The total is 2311 Calories. Therefore the available heat would decompose $\frac{231{,}070}{2311} = 100$ cubic metres of steam, or 80·4 kilos. of water at 0° C. But each cubic metre of steam comes into contact with $\frac{119{,}070}{100} = 1191$ Calories, which would be sufficient to raise it to a temperature of

$$100 + \frac{1191 - 511}{0{\cdot}55} = 100 + 1236 = 1336^\circ \text{ C.};$$

and since the temperature of the waste gases only varies between 1000° and 1250° C., the whole of their heat cannot be taken up by the water vapour. The same difficulty crops up on attempting to use the heat of the waste gases only in raising the temperature of the secondary air, and therefore it is necessary to divide the heat in question between the steam and the air.

If the sensible heat is divided equally, 212 Calories of the 425—*i.e.*, $\frac{119{,}070}{280}$—available per cubic metre of waste gas are transferred to the air, heating it to $\frac{212}{0{\cdot}32} = 660^\circ$ C. Therefore, out of the total heat developed—viz., $825\left(\text{*i.e.*}, \frac{231{,}070}{280}\right)$ Calories—425 − 212 = 213 are transferred to the steam; leaving 612 Calories to heat the coke. The weight of coke needed to evolve 112,000 Calories is $\frac{112{,}000 \times 0{\cdot}1018}{612} = 18{\cdot}6$ kilos., which yields $\frac{18{\cdot}6}{0{\cdot}1018} = 182{\cdot}7$ cubic metres of waste gas. The gas contains $182{\cdot}7 \times 425 = 77{,}648$ Calories, of which $182{\cdot}7 \times 213 = 38{,}915$ Calories are transferred to the water and steam. The cooling of the coke from 1250° to 1000° C. evolves 112,000 Calories, so that the water-gas process yields $38{,}915 + 112{,}000 = 150{,}915$ Calories. This permits an introduction of $\frac{150{,}915}{2311} = 65{\cdot}3$ cubic metres of steam, equivalent to 52·5 kilos. of water at 0° C. The waste gases give up $\frac{38{,}915}{65{\cdot}3} = 596$ Calories to each cubic metre of steam, thereby raising it to $100 + \frac{596 - 511}{0{\cdot}41} = 307^\circ$ C.

If it were desired to abolish the blow, the following amounts of heat would have to be communicated to each cubic metre of steam so as to raise it from 100° to 1000° C.: $900 \times 0{\cdot}503 = 453$ Calories *plus* that absorbed in decomposing at (say) the same temperature as already contemplated—viz., 1125°—*i.e.*, 1267 Calories. The total is 1720 Calories, which, transferred to 1 cubic metre of dry steam at 100° C. would raise it to

$$100 + \frac{1720}{0{\cdot}70} = 100 + 2457 = 2557^\circ \text{ C.}$$

It may be asked what quantity of steam can be introduced into an oxy-hydrogen flame playing over hot coke without reducing the temperature of the flame below 1000° C. On combustion, 1 cubic metre of hydrogen evolves 2600 Calories, and the 1 cubic metre of vapour formed absorbs $1000 \times 0{\cdot}49 = 490$ Calories, when it is heated to 1000° C. Hence 2110 Calories remain, of which 1283 Calories are consumed in decomposing 1 cubic metre of water vapour. The net residue is 827 Calories, available to convert water vapour into water gas. Now, to raise 1 cubic metre of steam at 100° to 1000° C., $900 \times 0{\cdot}503 = 453$ Calories are needed, and to decompose it (dissociation phenomena and variations in temperature being neglected) 1283 Calories. The total is 1736 Calories. Therefore, $\frac{827}{1736} = 0{\cdot}467$ cubic metre of water vapour can be led into the flame for every cubic metre of hydrogen burnt.

VII.—Temperature of the Oxy-Hydrogen Flame.

If no dissociation took place, the temperature of an oxy-hydrogen flame would be $\frac{2600}{0{\cdot}79} = 3290^\circ$ C. Based on Haber's formula for the decomposition of water vapour at high temperatures,

the equilibrium constant (K) for different temperatures on the centigrade (t) or the absolute (T) scale is as follows:—

T		t		K
1700	..	1427	..	34072
2273	..	2000	..	561
2500	..	2227	..	194
2773	..	2500	..	70·4
3273	..	3000	..	18·4

Hence (p = 1 atmosphere),

$$K = \frac{p\,H_2O}{p\,H_2 \times \sqrt{p\,O_2}}.$$

In the present case

$$p\,H_2O + p\,H_2 + p\,O_2 = 1, \text{ whence}$$

$$K = \frac{1 - \frac{3}{2}p\,H_2}{p\,H_2 \times \sqrt{\frac{p\,H_2}{2}}}.$$

At 3000° C. $p\,H_2 = 0{\cdot}15$, so that the combustion products of the flame consist of H_2, 15 per cent.; O_2, 7·3 per cent.; and H_2O, 77·5 per cent. by volume. Therefore $\frac{0{\cdot}775}{0{\cdot}775 + 0{\cdot}15} \times 100 = 84$ per cent. of the hydrogen is oxidized. In other words the extent of the dissociation at 3000° C. is 16 per cent. The heat developed is $0{\cdot}775 \times 2600 = 2015$ Calories, corresponding with a maximum temperature of

$$\frac{2015}{0{\cdot}775 \times 0{\cdot}75 + 0{\cdot}225 \times 0{\cdot}39} = 3012°\text{ C.}$$

When hydrogen is burnt in air, the nitrogen prevents so high a temperature being attained, and the dissociation increases with the reduction of the partial pressure. If no dissociation occurred, the temperature of the hydrogen flame in air would be 2000° C. However, since K is equal to 561 at 2000° C., and the combustion products contain about 35 per cent. of water vapour, the extent of the dissociation becomes

$$561 = \frac{0{\cdot}35 - \frac{3}{2}p\,H_2}{p\,H_2 \times \sqrt{\frac{p\,H_2}{2}}}.$$

Approximately 2·6 per cent. of the water vapour is dissociated, instead of 16 per cent. at 3000° C. and atmospheric pressure. At 2000° C., and atmospheric pressure, 1·9 per cent. of water vapour is dissociated—*i.e.*, 0·7 per cent. less than when the pressure is only 0·35 atmosphere.

VIII.—Temperature of Carbon Monoxide Burning in Oxygen.

Neglecting dissociation, the temperature would be $\frac{3046}{0{\cdot}92} = 3311°$ C.

Using Haber's formula for the dissociation of CO_2, the following data are obtained:—

T		t		K
1800	..	1527	..	3418
2600	..	2327	..	23·5
2773	..	2500	..	12·76
2973	..	2700	..	7·16
3048	..	2775	..	5·93
3273	..	3000	..	3·67

For the temperature of 2775° C., the following may be calculated: $p\,CO = 0{\cdot}272$; $p\,O_2 = 0{\cdot}136$; $p\,CO_2 = 0{\cdot}592$. This composition of the combustion products corresponds with a development of $3046 \times 0{\cdot}592 = 1803$ Calories, and with a flame temperature of

$$\frac{1803}{0{\cdot}592 \times 0{\cdot}84 + 0{\cdot}408 \times 0{\cdot}38} = 2764°\text{ C.}$$

The latest data for the dissociation of water vapour and carbon dioxide are those of Nernst and Wartenberg. Comparing them with the figures quoted by Haber, we have:—

	t	Nernst and Wartenberg.	Haber.
H_2O . .	1427 ..	0·101 per cent. ..	0·12 per cent.
,, . .	2227 ..	3·43 ,, ..	3·66 ,,
CO_2 . .	1527 ..	0·474 ,, ..	0·55 ,,
,, . .	2327 ..	16·8 ,, ..	13·9 ,,

In our present state of uncertainty respecting specific heats at high temperatures, the above mentioned degree of uniformity must be considered satisfactory.

If carbon monoxide obtained from a producer is burnt at 0° C. with air, the combustion products contain theoretically 20 per cent. of CO_2, and the maximum temperature should be

$$\frac{3046 \times 0{\cdot}21}{0{\cdot}64 \times 0{\cdot}21 + 0{\cdot}79 \times 0{\cdot}35} = 1569°\text{ C.}$$

At this temperature the constant $K = 3418$ shows the extent of dissociation to be only 0·86 per cent. It is therefore too small to be of any importance.

In a recent number of the "Journal," it was mentioned that Professor Thomson had been awarded the Nobel Prize for physics. It is stated that he purposes devoting half the amount to purposes of scientific research.

SCOTTISH JUNIOR GAS ASSOCIATION.

Eastern District.

The members of the Eastern District Section of the Scottish Junior Gas Association, to the number of about sixty, paid a visit to the New Grange Meter-Works, belonging to Messrs. Alder and Mackay, on Saturday last. In order that the visitors might see the works going, it was arranged for the members to assemble at the early hour of half-past eleven; but, for the convenience of those who could not leave their duties then, a second contingent was shown round at three o'clock in the afternoon. The company were received by Mr. A. Mackenzie, and, having been divided into small parties, under his leadership and that of Mr. J. Scott, Mr. J. Anderson, and Mr. Gray, the inspection of the works was begun. Every process in the manufacture of meters, pressure-gauges, and lanterns was shown, without reserve. At the conclusion, the firm's appliance for switching up and down incandescent gas-lights was shown in operation. There are twelve lights on the circuit, at heights varying from the basement floor to the top of a tower nearly 90 feet high; and all of these were, by the increase of pressure for a few seconds, instantly raised to full light or half or the whole of them extinguished, according as arranged. It was stated that lights a mile distant could be operated almost as speedily.

The inspection by the first party being over, they returned to Edinburgh, where they were entertained by the firm at luncheon in the restaurant of Messrs. Ferguson and Forrester, Limited—Mr. Mackenzie being in the chair.

Before separating, Mr. W. Brown (Lasswade), the President, expressed the indebtedness of the Association to Messrs. Alder and Mackay, and also to their assistants, for having given them the opportunity of visiting their important and up-to-date works. He said that the manufacture of gas-meters was closely allied to that of gas; and much that they had seen that day was well worth remembering. Few of them had any idea that a meter had so many intricate processes to go through before it attained the state of completion in which it reached their hands. The machines installed by Messrs. Alder and Mackay were of the most modern description, and fitted to produce an article in the most highly finished manner, which, no doubt, accounted for the fact that their meters had won the confidence of purchasers. The members had also had an opportunity of seeing one of the latest patents of the firm—that of the automatic lighter and extinguisher, which would doubtless prove a further success, and should serve a useful purpose, in enabling those connected with the gas industry to cope with their powerful opponent the electric light. He asked them to give a very hearty vote of thanks to Messrs. Alder and Mackay for the pleasure they had afforded them; and also to the various gentlemen who had so kindly put their services at their disposal.

Mr. Mackenzie, in response, assured the company that if their visit had been a pleasure to them, it had been equally so to the firm, as well as to himself, to have them there. The interests of the gas profession were bound so closely together that they were like the fingers of a hand. The firm happened to be one of the fingers; and it was their intention to keep their part of the work in the forefront. He would remind the members that, as juniors, they had great responsibilities, and that they were looked to to uphold the fair fame of gas lighting and the gas industry in the future.

After the inspection by the second party, they, and as many of the first party as cared to remain, were entertained to a substantial tea at Messrs. Ferguson and Forrester's. Mr. D. Bisset (Edinburgh), on behalf of the guests, conveyed their thanks to Messrs. Alder and Mackay, for having made the visit so enjoyable. Mr. Mackenzie and Mr. Scott having spoken briefly in acknowledgment, an hour was spent in recreation; and the proceedings were brought to a close, shortly after seven o'clock.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by Correspondents.]

Limitation of Discounts by Act of Parliament.

Sir,—In the interesting and important leading article on "The Protection and Freedom of Competitors," in your issue of yesterday, I notice the following paragraph: "Associated with this question of emergency supplies, through connection with the power business, is that of the limitation of discounts. The privilege of differential price-making for electricity, according to use or quantity, is a freedom denied to many gas undertakings."

May I, in this connection, draw the attention of your readers to a new provision which appears in the gas clauses of the "Model Bill (as amended 1906)" recently issued. At p. 69, against the "Discounts" clause, which has been included in the Model Bill since 1904, there now appears the following note: "This clause is not required where section 13 of the Gas-Works Clauses Act, 1847, is amended, as appears in clause 1, p. 62." The amendment at p. 62, thus referred to, is to the effect that the Gas-Works Clauses Act, 1847, is incorporated subject to a proviso that section 13 shall be read as if the words, "provided also that every such contract entered into by the company

shall be alike in terms and amount under like circumstances to all consumers," were added at the end of that section.

It will be observed that a gas company placed under this provision, instead of under the model discounts clause, will be in a position very similar to that of an electric lighting company under sections 19 and 20 of the Electric Lighting Act, 1882, which read as follows:—

> 19.—Where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the Licence, Order, or Special Act authorizing such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply.
>
> 20.—The undertakers shall not, in making any agreements for a supply of electricity, show any undue preference to any local authority, company, or person; but, save as aforesaid, they may make such charges for the supply of electricity as may be agreed upon, not exceeding the limits of price imposed by, or in pursuance of, the Licence, Order, or Special Act authorizing them to supply electricity.

Palace Chambers, Westminster, Dec. 12, 1906. F. N. KEEN.

The Simmance-Abady "Flicker" Photometer.

SIR,—Those of your readers who are interested in the question of photometry will, no doubt, be glad to know the following facts.

It will be remembered that when Mr. Simmance and I patented the "Flicker" photometer, in 1903, there were discussions in connection with various papers which were read by ourselves and others; and we strongly insisted, not only on the entire originality of our conception of the "Flicker" photometer, but also on the difference between our conception and the construction of what had previously been known as "Flicker" photometers, which we condemned as unscientific instruments—so much so, that we embodied the statement of our view in the forefront of our specification, and laid down certain rules. We obtained our patent in England; this being confirmation, so far as it went, of our view. But in those days, before the new Patent Act, the obtaining of an English patent was merely a perfunctory operation.

In 1903, we also applied for a German patent; and all sorts of objections were raised. We, however, fought the matter with the German Patent Office, who went carefully into the question, and have at last come to the conclusion that the rules we laid down (for which we claimed a patent) for the construction of "Flicker" photometers were original; and we have just heard—after three years of fighting—that a patent has been granted to us, and sealed.

Of course, the facts I adduce may be taken by some as being in the nature of an advertisement; but such an idea is very far from my thoughts. I think it is of scientific interest to know that the rules we laid down for the construction of "Flicker" photometers, which we claimed to be absolutely novel, have been admitted as novel by so high an authority as the German Patent Office. This goes a long way towards settling the question as to what really is a "Flicker" photometer.

Fountain Court, Temple, Dec. 12, 1906. JACQUES ABADY.

The Disposal of Ammoniacal Liquor in Small Works.

SIR,—I would advise "Gas Manager" to erect a shallow furnace of the reverberatory type—one, say, 4 feet by 4 feet by 9 inches deep at the centre, with a shallow evaporating pan, about 6 inches deep, of the same dimensions underneath. The flue of the furnace should be connected to the retort-house shaft. The cost of it will not exceed £5. This system dealt with a much larger quantity of liquor—very effectually, and without nuisance—at the works under my management.

"Gas Manager" is wise not to put down a sulphate plant with his present make. The results given in Messrs. Biggs, Wall, and Co.'s letter in the current issue, are too "rosy." Fair average ammonia producing coal carbonized at a moderate temperature would yield, in practice, about one ton of sulphate of ammonia per 100 tons of coal, or (say) 8½ tons at £11 per ton—the average net price obtained by small gas companies within 50 miles of London during the current year—which would equal £93 10s., and not £132. The cost of acid is also underestimated by about 10s. per ton at the least.

Correcting these figures, the result of a year's working would yield a gross profit of £55 5s.; and to obtain this result a good plant would have to be erected, at (say) a cost of about £500, without buildings. Taking the very moderate allowance of 10 per cent. to meet interest and renewal charges, a net profit is shown of £5 5s., and the effluent, the disposal of which sometimes costs a considerable sum.

Dec. 14, 1906. S/A

Christmas Boxes and the Prevention of Corruption Act.

SIR,—The Act (which is before me), though dated Aug. 4, 1906, says distinctly—Clause 4: "This Act shall come into operation on the 1st day of January, 1907." Are you not mistaken in saying that the Act is retrospective to Aug. 4, 1906? With all due deference to Mr. T. A. Nelham, I cannot find anything in the Act by which it could be possibly construed to be retrospective.

Dec. 12, 1906. NOT A LAWYER.

[Although the Act does not come into operation until Jan. 1, it may commence "operation" (according to legal interpretation) by dealing with the matters that come within its scope occurring "after the passing of the Act." The Act was passed on Aug. 4 last. Between now and Jan 1 there will be plenty of opportunity of producing the necessary offence to effectually challenge the legal interpretation as to the retrospective character of the Act.—ED. J. G. L.]

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Wednesday, Dec. 12.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* HARDY *and* FARWELL.)

Chappell v. West Ham Gas Company.

This was an appeal by a workman from a decision of his Honour Judge Russell, who dismissed an application to review, made under Schedule I., paragraph 12, and under liberty to apply in a previous order made by the same learned Judge.

Mr. A. POWELL, K.C. (with him Mr. W. M. THOMPSON), said the appellant contended that the learned Judge was wrong in law in saying that there were no new grounds, and that he was bound by his previous decision. Chappell, who was a scoop-driver in the gas-works, earning between 42s. and 43s. per week, in February, 1904, lost his right eye by a rivet flying and striking him. He gave the usual notice, and the Company agreed that he was entitled to £1 per week; therefore there was no arbitration. The amount named was paid until Aug. 6, 1904. Subsequently Chappell filed the agreement with the Registrar (which was equivalent to an award), in order that he might take steps to get his money. On May 20, 1905, the Company gave notice of an application to remove the memorandum of agreement from the register, on the ground that they disputed the man's incapacity to work and also the extent of the incapacity. This application came on for hearing on June 6, 1905, when evidence was given by medical men to the effect that one eye was quite enough for a gas stoker, and there was also evidence by a man in the service of the Company who had one eye, who said he worked as a scoop-driver. Thereupon the Judge found that Chappell had on the 2nd of June recovered his wage-earning capacity; and he ordered the Company to pay arrears to that date, after which compensation was to cease. He also gave "liberty to apply." During the next eleven months, Chappell made efforts in different directions to procure employment, with varying success—only getting odd jobs; and on the 9th of April application was made to the Judge to review. After hearing the case, he declined to alter his previous decision, considering that there were no fresh grounds. Having read the evidence given at the last hearing, and the judgment delivered, Counsel submitted that the Judge had gone wrong in law.

Mr. BEVAN, for the respondents, was not called upon.

Their LORDSHIPS held that the learned Judge was perfectly right in law, and dismissed the appeal, with costs.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, Dec. 12.

(*Before Mr. Justice* KEKEWICH.)

In re the Kent County Gaslight and Coke Company, Limited, ex parte Gollmann and Others.

These were four motions, under section 35 of the Companies Act, by shareholders in the above-named Company, asking for a rescission of their contracts to take shares, a return of money paid, and interest thereon at 4 per cent.

Mr. P. O. LAWRENCE, K.C., appeared for the first applicant, Mrs. Clara Gollmann, and Mr. MARTELLI for the others—viz., Mr. W. J. Bradsell, Miss J. E. Bradsell, and Mr. G. T. Baker. Mr. KIRBY represented the defendants.

It was decided that each case must be taken separately.

Mr. LAWRENCE, in opening the first case, said Mr. Justice Joyce had already given a judgment dealing with the prospectus of the Company; and he suggested that the evidence given before him should be taken as applicable to the present motions. He had a transcript of the evidence, and an affidavit could be made by the shorthand writer verifying the notes.

Justice KEKEWICH said he should certainly accept Mr. Justice Joyce's decision on a question of fact.

After a short discussion, it was arranged that the evidence given in the former cases should be considered as taken in these, except such as related only to the personal claim of the respective applicants.

Mr. LAWRENCE, having read Mr. Justice Joyce's judgment, read the affidavit of Mrs. Gollmann, in which she stated that she read the prospectus in the "Daily Telegraph," and, relying on the statements with reference to Mr. Darwin being a Director and Chairman, and his previous experience, the district to be served, the anticipated consumption of 50 million cubic feet of gas per annum, and the purchase price of the works, she applied for 100 shares and paid £500. If she had known that the works the Company were to pay £21,000 for had just been purchased for £2300, she would not have applied for shares.

Cross-examined by Mr. KIRBY, witness said she first knew that Mr. Darwin was not a Director when she read the report of the case before Mr. Justice Joyce. On the same day she had a letter from the Company saying she would get her dividend on the 1st of December. She immediately communicated with the Solicitors in that case.

Mr. KIRBY said he could not contest this case further, if his Lordship followed the decision on the prospectus.

Justice KEKEWICH said the order would be the same as that made by Mr. Justice Joyce.

Mr. KIRBY asked that execution should be stayed on the same terms as in the other cases.

Mr. LAWRENCE assented, provided the money was brought into Court by Friday, the 14th inst.

Mr. KIRBY asked for four days, which was the usual time.

Justice KEKEWICH said he was not disposed to give any indulgence in this case; the money must be brought in on Friday.

Mr. MARTELLI then opened the motion by Mr. W. J. Bradsell; the same arrangement being made about the evidence. He said Mr. Bradsell and his sister each applied for four shares, and they had made a joint affidavit. On beginning to read it, to the effect that the deponents read and discussed the prospectus, and noticed certain points in it,

Justice KEKEWICH (interposing) said he had seen so many affidavits that it would be a strong thing to say that this was the worst he had ever had before him; but whoever framed it had not the slightest notion of the elementary rules of evidence. The deponents must be called to give their evidence separately.

Mr. *W. J. Bradsell* was then sworn, and gave evidence as to reading the prospectus and the points in it which induced him to apply for shares.

In cross-examination, he said his suspicions were first aroused by an article in the "Tatler" about the end of May, which described the project as a "wild-cat" scheme, and said some of the districts marked on the map were tiny villages. Nothing was said about Mr. Darwin. Witness first heard from a friend that he was not a Director. On reading the "Tatler" article, he wrote to the Company, and on the 9th of June he got an answer from the Secretary which contained an extract from the minute-book.

Mr. KIRBY submitted that this applicant had delayed too long, and was not entitled to relief to the prejudice of other shareholders. He knew the facts at the end of May or the beginning of June, and did not move until the 4th of December. Meanwhile, the Company had changed their position, having paid all the purchase-money. In some cases, a delay of a fortnight had been held to be fatal to such an application.

Justice KEKEWICH, in giving judgment, said the necessity for coming promptly in such cases as this had been recognized again and again, and rested upon sound principles of equity and common sense. Promptitude might mean within a fortnight or a very short time; but the question was from what point it was to date. It must be from the time the applicant had good reason to believe that what he complained of as false was false. In this case, he had no doubt that Mr. Bradsell knew pretty well for the best part of six months before his present application that the statements respecting Mr. Darwin were untrue; and if he relied on this mainly—certainly if he relied upon it only—he would be out of court. But this was not the sole ground of his application. There were other things which he found out, or, if he did not find them out, he had very good reason for supposing that there were misstatements in the prospectus. But there were some things which apparently he did not know, and could not know. For instance, the quantity of gas to be consumed, which he had said was a matter that moved him in applying for shares. Besides this, he could not have known, until the investigation before Mr. Justice Joyce, that the prospectus was a swindle, and the Company also a swindle. He had sworn—and it was consistent with all one's experience in these cases—that he relied on the whole prospectus; and the prospectus had been held to be false as a whole. He (Justice Kekewich) did not see that there was any ground for holding the application to be out of time; and he should therefore make the same order as in Mrs. Gollmann's case, except that he should disallow any costs of the joint affidavit, on which he made some further comments.

Miss *J. E. Bradsell* was then called, and gave similar evidence to her brother; and the same order was made in her case.

Mr. *G. T. Baker*, who applied on May 22 for 60 ordinary shares, which were allotted to him, and on which he had paid £300, was the last applicant. He had issued a writ against the Company in October; but Mr. Martelli undertook on his behalf that the action should be discontinued. There was no objection to his affidavit, which was read, and set out what he relied upon.

In cross-examination, he said he did not know that Mr. Darwin was not a Director until he received a report of the statutory meeting of the Company, wherein it was stated that he had sent in his resignation; but the Directors had been advised by their Solicitors not to accept it. His attention was first drawn to the unsatisfactory character of the Company by a friend of his, who sent him a paragraph from a morning paper. He then, in the latter part of July, wrote to the Solicitors, and made an appointment to see them in August; but the gentleman who was attending to the matter was away, and he was not able to see him until October. As soon as he knew the facts, he issued the writ.

Mr. KIRBY submitted that this application must be dealt with quite independently of the action which had been commenced and abandoned, and that it was too late,

Justice KEKEWICH said his observations in Mr. Bradsell's case applied equally to this, and the order would be the same.

Friday, Dec. 14.

Whitaker v. Kent County Gaslight and Coke Company, Limited.

This was an action by Mr. William Butler Whitaker, of Blackheath, a retired gas engineer, to rescind his contract to take 50 ordinary and 50 preference shares in the above-named Company.

Mr. LAWRENCE, K.C., and Mr. DRAPER appeared for the plaintiff; Mr. KIRBY represented the Company.

Mr. LAWRENCE very shortly opened the case and called the plaintiff, who said he received on May 15 a copy of the prospectus, which he read with some care. What struck him most was the reference to Mr. Darwin and his experience; and the prospectus appeared to him to be a very attractive one. On Saturday, May 19, late in the afternoon, he sent in his application; and the next Monday he received a letter of allotment. On May 23 his attention was called to an article in a morning paper referring to the Company, and saying "The Chairman now seems to have become dissatisfied, and has resigned. The marvel is that he ever went on the Board at all, since he had a reputation to lose." He immediately telegraphed to the office announcing the withdrawal of his application, and also wrote and posted a letter the same afternoon confirming his telegram. In the evening he consulted his Solicitor, and on May 26 the writ was issued.

Mr. KIRBY said he did not raise any question of delay in this case; and assuming his friend did not wish his Lordship to go beyond the findings of fact arrived at by Mr. Justice Joyce, he did not desire to cross-examine the plaintiff.

Mr. LAWRENCE said he asked for the same order as in the previous cases, with a preface to the effect that the evidence of fact as to the untruth of the statements in the prospectus was proved by the affidavit evidence given before Mr. Justice Joyce, and also by the transcript of the oral evidence.

Justice KEKEWICH said that would be the order.

Earlier in the day, it was stated that there were motions by a number of other shareholders to be relieved of their shares and obtain repayment of their money; but they all stood over until next Thursday (the 20th inst.), when a petition for the winding-up of the Company will probably be considered.

A QUESTION AS TO "PROPER FACILITIES" FOR TESTING.

Interesting Case at Herne Bay.

At the St. Augustine's Petty Sessions last Saturday week—before Lieut.-Col. DICKENSON and a Bench of Magistrates—the Herne Bay Gas Company were summoned by the Urban District Council for failing to provide a testing-place and apparatus, for failing to give the Council access to the testing-place required to be provided, and for failing to afford facilities for the proper execution of the provisions of the Gas-Works Clauses Act, 1871.

Mr. J. JUBB, the Clerk, appeared for the Council; and Mr. F. COLAM (instructed by Messrs. Sharpe, Parker, and Co) represented the Company.

Mr. JUBB said the question raised on the summonses was a very novel and highly technical one, which practically called for the interpretation by the Court of a particular word, or a series of words, comprised in the Herne Bay Gas Order, 1899. Clause 28 of the Order read: "The undertakers shall, within six months after the commencement of this Order, cause to be provided at the office of the Herne Bay Urban District Council a testing-place with apparatus therein according to the provisions of the Gas-Works Clauses Act, 1871." This Order was the authority under which the Company exercised their powers of supplying gas to the Council. The Order having been granted, it was confirmed by the Gas and Water Orders Confirmation Act, 1899; and the clause read was included therein. Though the Order became law so long ago, the Company had failed to carry out their obligations to provide a testing-station. In the latter part of 1904, certain complaints having been received as to the quality of the gas supplied by the Company, the Council decided to enforce compliance with the clause; and on Jan. 20, 1905, he addressed a letter to the Company stating that the Council wished him to refer the Company to the clause, and to require the provision in the Council offices of a testing-place with apparatus therein in accordance with it. In reply, the following communication was received from Mr. C. V. Bennett, the Manager:—

> In reply to your letter, I am requested by my Directors to state that they have not decided to avoid compliance with their obligations; for it will be recollected that at the time the Company obtained their statutory powers it was agreed that, as their works are at such a short distance from the Council offices, they should not, until called upon, incur the expenses for the Council and the Company which would be necessary for the installation in question. I am further directed to point out that, in order to comply with our own Act, and with the Gas-Works Clauses Act, 1871, Schedule A, it would be requisite for the Council to set apart exclusively a suitable room, and to appoint a competent and practised examiner to make daily tests, which take some considerable time; while the expense to the Company of the instruments would be about £90. The Directors would be glad to avoid this extra charge, inasmuch as it must ultimately fall upon the consumers; and they therefore ask the Council whether they will not be satisfied to make their tests on the Company's own apparatus, which is in accordance with the requirements of the Act, in a room specially built for the purpose, and is, and always has been, open to the Council. This course is generally adopted where the works are at such a short distance from the offices of the Council.

It would be seen from this that the Company had already, for their own purposes, provided a testing-place with apparatus therein at their works; but as this place was only accessible through the Manager's private office, the Council considered, in the interests of the consumers and the ratepayers generally, they must have one more easily accessible to their own testing officer. In reply to the Company's letter, he wrote saying that the Council did not consider the Company should be relieved of their responsibility to provide the testing-place and apparatus in the Council offices; and they accordingly requested compliance with the Order. After this letter had been sent, an interview took place between the parties; and it was suggested that the difficulty might be got over if the Company provided a separate entrance to their existing testing-place. The Company, however, declined in the first instance to grant this facility; but afterwards they were willing to concede it conditionally upon the Council accepting it for all time in lieu of the testing-place to be provided under the Order, and agreeing to waive their rights under the clause. This the Council naturally declined to agree to, but offered to accept the testing-station at the works for an experimental period of three years, at the same time assuring the Company that if the arrangement proved satisfactory they would be willing to renew it. The Council afterwards even went so far as to offer, in the event of requiring the Company to provide the new testing-place in five years, to recoup them any cost they might have incurred in connection with the separate entrance. The Company did not

accept this offer; and the Council modified it with the proviso that if, at the end of the experimental period, the Council found it necessary to enforce clause 28 of the Order, the Company would accept the interpretation of the words "testing-place" in such clause to include the provision, at the expense of the Company, of a building at the Council offices to contain the apparatus. As the Company were not prepared to accept this offer, the Council last July required them within two months to fulfil their obligations under clause 28 of the Order. The Company then asked where, at the office of the Council, it was desired that the testing-place should be; and a plan was sent them with the spot marked on it.

Mr. COLAM: There is a rough yard there. The whole point is whether we are to provide an independent building or not.

Mr. JUBB: It is in an enclosed yard, and part of the Council offices. The Council were not wedded to this particular spot; and if the Company considered that any other place nearer the offices or adjoining them would be more convenient, provided it were possible, the Council would be glad to meet them in the matter. The Company, however, had declined to provide the testing-place at this spot, because fixing it there would involve the erection of a building to enclose it; and this the defendants were not prepared to do, as they stated there was no obligation on them. The Company had frequently contended in the correspondence that the requirement for the provision of a testing-place did not entail upon them the duty of providing a suitable building to house the apparatus, and that accommodation for the same must be found in the existing offices of the Council, or in a structure to be provided and erected by the Council. The Council had made overtures to the Company with a view of saving expense to them; but they had always absolutely declined, in the interests of the ratepayers and of the consumers generally, to go to the length of waiving their rights under the clause till after an experimental period had elapsed to enable them to ascertain whether the proposals of the Company to give them a separate entrance to the testing-station would work satisfactorily and would be to the benefit of the consumers. The Council joined issue with the Company in their interpretation of clause 28; and it was principally for the purpose of having this point determined that the proceedings had been brought.

Mr. COLAM said the simple issue was, the Council's own clause said "at the offices of the Council." This was what they had asked Parliament to give them.

Mr. JUBB said if reference was made to the Gas-Works Clauses Act, 1871, which was incorporated in the Order, it would be seen that clause 28 was, with the substitution of the definite place and time instead of the prescribed place and time, practically identical. It would be seen from the section that a testing-place was to be provided at the place prescribed. Therefore the words "testing-place" in the Order could not have reference to the offices of the Council, because the testing-place was to be provided at that place. Again, the Company were to provide a testing-place with the apparatus therein. It was logical to assume that the word "therein" implied that the testing-place should be some enclosing medium, apparently for protective purposes.

Mr. COLAM: I agree, it must be an enclosing medium.

Mr. JUBB: And the Company are to provide the enclosing medium.

Mr. COLAM: And at the offices.

Mr. JUBB: Are you going to say that "at the offices" means "in the offices?" I say "at" is not "in;" but that "at" means within the curtilage of the Council offices. The Gas Company know very well that our existing building is absolutely unfitted, by reason of the instability of its foundations, for the delicate operation of testing gas. The building is erected on the site of a pond; and the vibration from passing vehicles would seriously affect such a delicate operation. Then the resources of the building are greatly taxed for the administrative work of the Council.

Mr. *F. W. J. Palmer*, Surveyor to the Council, was called, and gave evidence as to the impossibility of the test being properly made in the Council offices; but he thought it might be carried out in the yard on the spot marked in the plan. The ground was more solid there, and the vibration would not be so great.

Mr. COLAM said they would find that under the main Act there was no prescribed position or place for anything. The clauses left this to be prescribed by the Special Act; and the Company were required by the Special Act to fix the testing-place at the offices of the Council. Now the difficulty was to say what was the meaning of "place," and what was the meaning of "at the offices." The word "place" was used in obviously different senses. Section 28 spoke of providing a testing-place at the place prescribed. So they saw that the Statute was speaking of a testing-place as if it were totally different from the place at which the testing-place had to be put. He said, therefore, that when they spoke of a testing-place it meant some convenience for testing which could be put in some other place; and then the Special Act defined the place in which the testing-place had to be put as "at the Council's offices." This the Company had always been ready to do. They had never refused to set it up there. The Council themselves had construed the Act in this way; and when they first wrote to the Company they asked them to put the testing-place "in the Council offices." It was agreed that the testing-station at the gas-works should be used; and this went on till 1905, when for some reason or other the Council required the Company to put the testing-place in the Council offices. Then the Company wrote that they would provide a separate door and key to enable them to get to the apparatus, which was always kept in order, as it had to be used every day. But the test was not to be binding unless made in the presence of the Company's representative. As a concession, also, the Company agreed with the Council that they would reduce the price of gas for certain lamps; and this arrangement was to exist for three years. They thought the whole thing was settled. The concession as to the price of gas being withdrawn, the Council requested that the testing-place should be erected at their offices. Thereupon the Company wrote asking to be shown where at the offices it should be erected, as they were perfectly willing to do it. When the Manager attended at the offices to have the place pointed out, they said the testing-place was not to be in the offices, but in the yard; and that "testing-place" meant separate building. There was nothing as to this in the Act. All the Act said was that the Company must have a testing-place "at the offices of the Council." This had been construed by the Company "in the offices." The Council thought they could dictate to them that they must not only provide a case for the apparatus—which they argued was a place—but that they must erect a house to put it in; and that was going too far. He thought it was quite possible to see the motive of this. The Council were perfectly willing to accept the separate doorway at the Company's offices till the Company refused to reduce the price of gas. Then they turned round, and said to the Company: "It is true that in our negotiations we construed 'at' as 'in' the offices; but as you will not give way to us as to the price of gas, we will say that 'at the offices' is in the yard outside the offices." It was not intended by the Act that a separate building should be erected; but something that was self-contained, with the apparatus in it. The expression was "shall cause to be provided;" and so the Company had to pay for providing a place that should contain the apparatus. It was true that at the works there was a room as the place containing the apparatus; but it was not necessary. They could have a satisfactory testing-place without a room set apart, for they could have a place self-contained, as advertised in Messrs. Sugg's catalogue. There was a cabinet; and the doors being shut, it was possible to test everything as satisfactorily as if there was a separate room for the work. If the Council told the Company they could not give them room, that was not the Company's fault. The difficulty would be, if the Bench made an order against the Company, who was to decide what kind of building it was to be? The Company were willing to provide, at the offices, something in which the gas could be tested—which was a "place"—and by so doing, they would be carrying out everything that the Act required. The yard named by the Council as the spot for the testing-place was outside the offices; whereas the place must be the offices. Was "outside the offices" at the offices?

Mr. WILBEE (a Magistrate) said he thought it was.

Mr. COLAM: Then why did the Act not say so? It is certainly not in the Act.

After the luncheon interval,

The CHAIRMAN said the Bench had taken advantage of the opportunity to come to some conclusions so far as the case had gone. On the first information that the Company had failed to provide a testing-place and apparatus, they found they had no jurisdiction to deal with the matter. On the second information, they had come to the conclusion that, as there was no testing-place within the meaning of the Special Act, the Company were not guilty of failing to give access to what did not exist. The third information alleged that the Company had failed to afford facilities for the proper execution of the provisions of the Gas-Works Clauses Act, 1871; and they would ask Counsel to direct his arguments to this.

Mr. COLAM said the broad answer was that if there was no testing-place there could be no failure to give access to it. The marginal note to the section was "Access to the Testing-Place." If there was no testing-place, there could be no refusal to allow access to it; and as that was the answer to the second information, so also was it the answer to the third. What tittle of evidence had they of any other facility refused with regard to this except failure to give access to a place that did not exist? Section 34 of the General Act was inapplicable to the place which was contemplated by section 28 of the Private Act. If section 34 were applicable, instead of having the testing-place at the Council offices, it would have been prescribed by Parliament perhaps at the office on the gas-works, and would then be a place under the control of the Company, to which the Company could give the Council access. Facilities meant giving access to the place at the works, and when there giving access for using the apparatus, turning on the gas and letting them have instruments, and so on. They would give them facilities when the Company had given access. The section was inapplicable, because the place contemplated by the Council's own Act was not a place open to the Company's control, but had to be at the Council's offices. It was for the High Court to construe whether the place was within section 28; and he said that section 34 was never meant to apply except to premises which were left to the Company's control by being on the Company's premises. This was the technical answer to the third information charged against the Company.

Mr. JUBB said he thought it was for the Bench to decide whether the Company could be said to have afforded facilities for the carrying out of the purposes of the Act. He submitted they had not. His friend's point was that clause 34 had reference only to access to an existing testing-place. He submitted that it went further, for it was laid down that the undertakers should give access, and should afford all facilities for testing. They had not afforded facilities, but had neglected to provide something which prevented them from carrying out the Act in its entirety.

The CLERK pointed out that there was a testing-place at the Company's own offices.

Mr. JUBB: That is for their purposes.

The CHAIRMAN: It has been the only testing-place for some time in the town.

Mr. COLAM said the Council had used it. Mr. Young, who had conducted the test, had presented his report, and said everything was satisfactory.

Mr. *Henry Woodall* was then called, and examined. He said there was in Messrs. Sugg's catalogue a photometer which did not require a darkened room, and which quite satisfied the Gas Referees. It could be placed anywhere at the offices—in fact, in the corner of a small room. It was quite well known in 1899, when the Order in question was granted. There would be no risk of vibration if one was placed in the Council offices. The containing-box was sufficient to constitute a "place." If it were placed in an open yard as it was, the instrument would deteriorate rapidly; but he did not think there would be any objection except the cost of maintaining. It did not require a building for testing; but it was never intended to put the apparatus in an open space, as it was a delicate instrument. As to the testing-place, he should say "in the office." Certainly, he should not advise the Company to put the testing apparatus in an open yard.

The CHAIRMAN (after the Magistrates had consulted in private) said they considered it was a difficult case. Two of the Bench were of opinion that the Company had not afforded facilities, and two thought they had. Therefore they dismissed the summons.

MISCELLANEOUS NEWS.

MODEL CLAUSES IN GAS BILLS.

At the close of each session, the House of Lords issue a paper of Model Bills and Clauses in Bills which the Board of Trade, in their reports to the Parliamentary Committees, suggest should be followed in all cases in which promoters do not voluntarily include the provisions. One of these Model clauses is referred to by Mr. F. N. Keen, in a letter which will be found in our "Correspondence" columns to-day—the proviso as to equality of treatment of gas consumers. Several other clauses are now given in somewhat altered form, in accordance with precedents created during the last session of Parliament.

Among others, the provision dealing with the disposal of shares or stock not sold by auction or tender appears in the following form:—

17.—(1) When any shares or stock created under the powers of this Act have been offered for sale by auction or tender, and not sold, the same may be disposed of by the directors at a price not less than the reserved price put upon the same for the purpose of sale by auction or tender, or may be offered at such reserve price to the holders of ordinary shares or ordinary stock of the company in manner provided by the Companies Clauses Act, 1863, or to the employees of the company, or to the consumers of gas supplied by the company, or partly to one or partly to another or others.

(2) Any shares or stock not so disposed of, or so offered and not accepted within the time limited by the directors of the company, shall again be offered for sale by public auction or by tender in the manner and subject to the provisions of this Act with respect to the sale of shares or stock created under the powers of this Act, and at such time or times as the directors may think fit; and any shares or stock not then sold may be disposed of by the directors at such price or in such manner as they may think fit.

The next considerable alteration is in the clause providing for the charge for gas supplied by means of prepayment meters. This, in its new form, is as follows:—

24.—(1) The company may demand for any gas supplied through a prepayment meter a not greater charge than for gas supplied to private consumers within their limits of supply through any other kind of meter or by any other method of supply.

(2) The company shall not charge for the hire of any prepayment meter and fittings to be used therewith any sum other than a sum of money calculated according to the quantity of gas supplied through such prepayment meter; and the maximum sum to be so charged shall be at the rate of 10d. per 1000 cubic feet supplied in manner aforesaid, such sum to include the hire of meter and the fittings used therewith, or at the rate of 1s. per 1000 cubic feet, if such fittings include a cooking stove. The said charge shall include the providing, letting, fixing, repairing, and maintenance of the meters and fittings, and the cost of collection and other costs incurred by the company in connection with the meter and fittings.

(3) The maximum charge for the hire of a prepayment meter without fittings shall be at the rate of 10 per centum per annum on the cost of the meter.

(4) For the purpose of this section, the expression "prepayment meter" means any meter or appliance by which the quantity of gas supplied is regulated according to the amount of money prepaid therefor.

The following clauses—dealing with quality of gas, testing-place, testing for quality, pressure, and saving as to penalties, appear in the following altered form:—

25.—The prescribed number of candles shall be not less than fourteen.

26.—For the purposes of the Gas-Works Clauses Act, 1871, the prescribed testing-place shall be a testing-place which shall be provided by the company on the lands described in the schedule to this Act [*or otherwise describe position*], before supplying or within three months after beginning to supply gas under the authority of this Act.

27.—(1) The quality of the gas supplied by the company shall, with respect to its illuminating power, be such as to produce, at the testing-place, when burned at the rate of 5 cubic feet per hour, a light equal in intensity to the light produced by 14 sperm candles of six to the pound, each consuming 120 grains of sperm per hour, and shall be in all respects in accordance with the provisions of the Gas-Works Clauses Act, 1871.

(2) For testing the illuminating power of the gas, the burner to be used shall be that known as the Metropolitan Argand No. 2, the photometer shall be the bar photometer [*or table photometer*], the standard light shall be that supplied by Harcourt's ten-candle pentane lamp, and in making the test the burner shall be so used as to obtain from the gas when burned at the rate aforesaid the greatest amount of light: Provided that the Board of Trade may on the application of the company or the local authority [* *the council or any five consumers*] approve the use of any other burner, photometer, or standard light which may appear to the Board to be equally or more suitable for the testing.

(3) The company shall, before supplying or within three months after beginning to supply gas under this Act, provide all the apparatus required by this Act for the testing of gas, and shall at all times keep the same in proper order and repair.

28.—(1) All gas supplied by the company to any consumer of gas shall be supplied at such pressure as to balance a column of water not less than 8-10ths of one inch in height at the main, or as near as may be to the junction therewith of the service-pipe supplying the consumer.

(2) Any gas examiner appointed under the Gas-Works Clauses Act, 1871, may, for the purposes of this Act, subject to the terms of his appointment, at the testing-place or at any public lamp,* as and when he thinks fit, test the pressure at which the gas is supplied. The company shall afford to the examiner all reasonable facilities for making the test.

29.—No penalty shall be incurred by the company for insufficiency of pressure, defect of illuminating power, or excess of impurity in the gas supplied by them in any case in respect of which it is proved that such insufficiency, defect, or excess was produced by any circumstance beyond the control of the company: Provided that the want of sufficient funds shall not be held to be a circumstance beyond the control of the company.

* Substitute these words in Local Authorities' Bills.

* In cases where there are no public lamps, provision may be made for testing elsewhere than at the testing-place.

EAST HULL GAS-WORKS PURCHASE PROJECT.

The Hull City Council last week held a special meeting to consider the expediency of promoting in the next session an Omnibus Bill for effecting the purchase of the Sutton, Southcoates, and Drypool Gas Company, to authorize the construction of a tramway, to acquire land compulsorily for the purpose of a public abattoir and cold stores and refrigerator, to provide an art gallery, to make bye-laws with reference to electric fittings and apparatus, and to confer upon the Corporation further powers in regard to the health, local government, and improvement of the city.

At the outset, letters were read from the Chamber of Trades and the Botanic and Park Ward Ratepayers' Association, asking the Council not to commit themselves before the Bill was discussed by trade and ratepayers' bodies. Alderman Rollit then pointed out that the Council could either vote on the Bill as a whole or take the clauses separately. It was moved and seconded that the clauses be taken separately; and Alderman Rollit proceeded to move the approval of the clauses referring to the purchase of the gas-works. This was seconded; and when the vote was taken, attention was drawn to the fact that Alderman Robson (who is interested in the Company) was voting. This led to some discussion, in the course of which Alderman Robson claimed his privilege to vote on the question "as to whether the matter should be discussed in the Council." There was considerable dispute as to what the vote was really on; and then Alderman Robson asked the Town Clerk if any person interested in the Company, and not desirous to sell, was entitled to vote or not. His own opinion was that the Legislature never intended to deprive a man of his right as a citizen in opposing a Bill to purchase property. If he wanted the Corporation to buy the property, his position would be untenable; but he did not. The Mayor stated that the ruling of the Town Clerk was that Alderman Robson could neither speak nor vote on the matter. Alderman Rollit said there had been some misapprehension; and it would be to the credit of the Council as a business body to have the matter discussed, and then take a vote. Another vote was accordingly taken, and resulted in favour of the clauses being discussed.

Alderman F. Larard, J.P., in seconding the formal resolution by Alderman Rollit, that the clauses relating to the gas-works purchase be approved, outlined the steps which the Council had taken in the matter, and pointed out that it was by their resolution that they went to Parliament last session and got a purchase clause inserted in the Company's Bill. Were the Council going to refuse to enable them to keep their pledge with Parliament to promote a Bill? What had been the policy of the Company? Immediately they gave notice last year, there was a reduction of 2d. per 1000 cubic feet in the charge; and now they were promoting the Bill there was notice of a further reduction of 4d. This would mean a saving to the consumers of £4425 a year; but would that go on? Was it not a dodge on the part of the Company to blind their eyes? [Alderman Robson: Absolutely not.] He supported the proposal for three reasons. The first was to get possession of their streets. In the past there had been gross mistakes in the taking up and laying down of streets by the Company, though he wanted to be fair, and to say that it had not occurred under the present management. Secondly, the policy of the Company had not been in the public interest. The Company said that they were restricted to a dividend of 7½ per cent.; but he thought he could show they had been in the position to get more. Thirdly, he advocated the proposal because he firmly believed it would be a financial success. He quoted figures to show that of the 265 gas undertakings owned by municipalities, only 11 made a loss.

Mr. Cockerline pointed out that the Council had not given any idea of the cost of the purchase; but on a vote being taken, the resolution was carried by a very large majority.

PENSIONING OLD GAS-WORKS EMPLOYEES.

Acrimonious Discussion at Devonport.

A discussion of a heated and uproarious character took place at the meeting of the Devonport Town Council on Thursday last, with reference to a recommendation of the Gas Committee that an allowance of 5s. per week be made for six months to an old employee of the gas-works. It was stated that the man had been engaged at the works for forty years, and was now incapable of continuing.

Alderman Bennee said the amount proposed to be given to this old servant was miserable. Although the man had not been in the employ of the Corporation for the long period in which he had been at the gas-works, the Corporation took over the liabilities as well as the assets of the Gas Company, and should treat these old men generously. Mr

Brenton contended that the Council should not place their employees on a level with ordinary paupers. It would not be excessive generosity if they doubled the proposed allowance. Mr. Rendle urged that they should run the gas-works on business lines. It had frequently been said that the ratepayers expected a profit from the undertaking; and in what the Committee had done in this matter, they had acted as business men. Mr. Bishop thought the principle that they should look upon this as a mere matter of business, was altogether wrong. In the transfer of the gas-works to the Corporation, ample provision was made for the heads of the department; but the working men were neglected. Alderman Stephens remarked that there was a difference between the case of the old employees of the gas-works and those who received a pension after completing a term of service under the Government. In the latter case, the pension was recognized as deferred pay; whereas in this instance there was no legal claim on the Council, who had owned the gas undertaking for only a few years.

Mr. Tozer was in favour of increasing the amount to 7s. 6d. a week; and moved that the matter be referred back to the Committee. Alderman Waycott, who had formerly been a Director of the Gas Company, supported this amendment, and said that they should remember the age of the man, and the fact that he had been worn out in the service of the gas-works. Mr. Paul, the Vice-Chairman of the Gas Committee, said he was amazed at the position taken up by Mr. Waycott. If the Directors of the Gas Company were really so keenly desirous to look after their old workmen, why did not they do it themselves? They had given the heads of the works remuneration for their past services, and might have seen to the case of these old servants, and not left them to the tender mercy of the Council. This was only one case. Were the Council prepared to pension twenty or thirty of the faithful servants of the old Gas Company? They had to be fair to the old men; but they had also to be fair to the ratepayers. He hoped the Council would consider that they had treated this particular case with generosity. Mr. Pryor pointed out that this man had been receiving money from the Gas Committee for a year or more—not for what he had done for the Corporation, but for what he had done for the old Company, whose bankrupt stock they took over. Mr. Monk thought the time was approaching when they would have to consider the question of pensions for their workers. He should like a Committee to be appointed to endeavour to draw up a scheme by which this could be arranged by means of contributions from the men and from the Corporation. Under the present want of system, one man might get a pension and another not; and this was not fair.

Alderman Hornbrook, the Chairman of the Gas Committee, remarked that many old men at the gas-works were not earning half the money they were receiving in wages. If they were going to support these men merely out of sympathy, he did not think it right. The whole thing was a legacy of a system which, when they took it over, was rotten to the core. This remark was received with a cry of dissent; and Alderman Hornbrook added that it was rotten in its material aspect, rotten in its management, and rotten from top to bottom, in every sense of the word. Alderman Bennee remarked that the Corporation were not asked to take over the works. Alderman Hornbrook replied that they took them over in the best interest of the town. If they had acquired them in the condition in which they were to-day, they would have had to pay another £100,000 for them. They took them over as a bad thing, and paid a bad price for them. Alderman Waycott protested against these allegations against the old Gas Company, and said it was conclusively proved in Parliament that the works were in a very satisfactory condition. Alderman Bennee said the Gas Company, so far from being anxious to part with the property which Alderman Hornbrook now abused, resisted the attempt of the Corporation to buy it. Alderman Hornbrook, in conclusion, said the question was whether they were to pension men who had grown old, not in the service of the Corporation, but in that of a private firm. This man should have been pensioned off ten years ago.

The proposal to refer the matter back to the Committee was lost, and the Gas Committee's recommendation was approved.

DETECTION OF WATER-GAS POISONING.

Some discussion has arisen in the "Birmingham Mail" over the report of Mr. L. C. S. Broughton's lecture, on "Blood: Its Medico-Legal Aspects," which appeared therein, and which we reproduced (with some comments) in last week's "JOURNAL"—pp. 733, 764.

In a letter to the Editor, Mr. Broughton said that in the report "there are some inaccuracies—not my own—which are so serious that I hasten to draw attention to them. For instance, I did not say that 'water gas is odourless;' it was carbon monoxide gas which I said was odourless. Neither did I say that 'water gas is forced into the mains in excessive quantities in foggy weather and at night, and that the high pressure under which it is sent out increases the danger of leakage.' But the most serious misstatement is that 'there is always, where incandescent burners are used, a certain proportion of the gas which escapes into the room.' Nothing could be further from my mind than to say such a ridiculous thing. As a matter of fact, the gas consumed in an incandescent burner undergoes more perfect combustion than in any other form of burner. There are several more errors; but, as they are not of importance from the public point of view, I need not deal with them."

To this the reporter replied in the following terms: "Mr. Broughton complains of inaccuracies in the report of his paper, disclaims all responsibility for them, and seeks to throw the onus entirely upon me. His first complaint is that he did not say water gas was odourless, but that carbon monoxide was. This does not correspond with my notes; and, if it were so, the whole point of Mr. Broughton's argument would disappear. The Birmingham Corporation, of course, do not supply carbon monoxide for the consumption of the citizens; they supply a mixture of carburetted water gas and coal gas, of both of which carbon monoxide is a constituent. The chief ground on which it has always been alleged that water gas is dangerous has been that it was odourless; hence the Bill which proposed that it should not be supplied for public consumption unless mixed with a sufficiently large proportion of coal gas to enable the public to detect an escape. Mr. Broughton appears not to have known that it is carburetted water gas, and not the 'blue' water gas used by some gas manufacturers, which is manufactured by the Birmingham Corporation. Mr. Broughton certainly did say that water gas was 'pushed through' the mains during foggy weather and at nights in quantities which he suggested were dangerous, and considerably in excess of the proportion supplied under normal conditions; and that the high pressure increased the risk of leakage. 'The most serious misstatement' was not attributed to Mr. Broughton at all. It was another member of the Society who made the 'ridiculous' remark 'that, where incandescent burners were used, a certain proportion of the gas often escaped into the room;' and it is well known that this is a fact if the burners are not properly regulated."

REGULATIONS IN REGARD TO WATER SUPPLY.

Proceedings of the Joint Committee.

The Joint Committee on Water Regulations, the formation of which has been noticed in the "JOURNAL," held a meeting at the Guildhall on Monday last week. Among the Local Authorities and Companies represented were the Metropolitan Water Board, Birkenhead, Birmingham, Bradford, Bury, Hull, Newcastle, Preston, South Hants, South Staffordshire, Stockport, and Weardale. In the absence of Dr. Robert Crawford, of Glasgow, the Chairman of the Committee, Mr. W. D. Caröe, F.R.I.B.A., Master of the Worshipful Company of Plumbers, was voted to the chair.

In opening the proceedings, the Chairman said that, if Dr. Crawford had been present, no doubt, he would have remarked on the work of the Committee from the point of view of the public health administrator and the water authority; but he himself regarded the matter rather from the point of view of the architect and the consumer. From his own experience, he found the greatest difficulty in dealing with the large number of varying regulations; and the Council of the Royal Institute of British Architects would warmly welcome the codifying of water regulations, and the setting up of such standards for fittings as would represent, at any rate, an irreducible minimum of efficiency.

Mr. E. Antony Lees (Birmingham) presented the report of the General Purposes Committee, together with a draft annotated model code of regulations, with schedules attached, setting out the specifications of water-fittings, &c., compiled from reports of the various Sub-Committees, and prepared in form for publication.

On the motion of Mr. J. Watson (Bradford), seconded by Mr. F. J. Bancroft (Hull), the General Purposes Committee were empowered to conduct the necessary negotiations with the Local Government Board, with a view to the inclusion of the draft code framed by the Committee in the model series of regulations issued by the Board for the purpose of Local Acts and Provisional Orders, enabling regulations to be made on the subject of the prevention of waste or the contamination of water. It was pointed out that, in view of the authoritative character of the conclusions embodied in the code, representing the majority of the larger water undertakings and three-fourths of the consumers of water in the United Kingdom, and also the practical opinion of architects, plumbers, manufacturers of fittings, and others specially conversant with the subject, the Local Government Board might confidently give a wider and more definite interpretation of their present powers, and thus secure greater uniformity of practice in regard to water regulations, to the great advantage of all concerned.

Mr. Fitzroy Doll and Mr. W. D. Caröe were added to the General Purposes Committee.

It was reported that the Admiralty had adopted, for use in His Majesty's Naval establishments, the standard specifications for water-fittings framed by the Joint Committee.

The report of the Standardization Committee was adopted, fixing the meetings of that Committee for the last Saturday in January, April, July, and October, to deal with new fittings and apparatus offered for standardization, and tested in London or at Belfast, Birmingham, Bradford, Glasgow, Newcastle, and Plymouth.

Communications were reported from a number of water authorities and others pressing for copies of the model code; but the Committee decided that the publication of the code should be deferred for a short time, pending the negotiations at present in progress with the Local Government Board.

Large Extensions Projected at Manchester.

The Manchester Gas Committee have resolved to recommend the Council to apply for sanction to borrow £300,000 for extension purposes. Of this, £100,000 is needed for the construction of a new holder at the Bradford Road works to contain 10 million cubic feet of gas. The largest holder at present in Manchester has a capacity of 7 million feet; and that also is at the Bradford Road works. A sum of £50,000 is required for the completion of the retort-house at Gaythorn; and the balance will be devoted to street-mains, service-pipes, meters, and stoves. In the last twelve years, the number of consumers supplied by the Gas Department has doubled; and the annual increase is equal to about 3½ per cent. The present storage capacity of the holders is 24½ million cubic feet; the largest day's consumption has reached 28 million feet.

The Wallasey Urban District Council, with whom negotiations were being conducted with regard to an advance to the Tiverton Town Council of £2240 required for the purposes of the gas undertaking, at 3¾ per cent., have declined to complete the transaction. The Finance Committee have reported to the Tiverton Town Council that it does not appear possible at the present time to obtain the amount at a lower rate of interest than 3⅞ per cent. It has been decided that further negotiations for the loan shall stand over until after Christmas.

CONTINENTAL UNION GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London offices, No. 7, Drapers' Gardens, Throgmorton Street, E.C.—Mr. FREDERICK TENDRON, the Deputy-Chairman, presiding.

The CHAIRMAN, before commencing the business, said he wished to express the great regret felt by their Chairman (Mr. Arthur Lucas) and his colleagues that he was unable to be present. He was unfortunately attacked by that prevalent disorder, influenza; and it had left him exceedingly weak. He trusted his absence would be excused.

The SECRETARY (Mr. W. Martin) having read the notice calling the meeting, the Directors' report [*ante*, p. 625] and the statement of accounts were taken as read.

AN EXPLANATION AS TO INTEREST.

The CHAIRMAN, in moving the adoption of the report and accounts, said he would first refer to the interest account, because there was something a little abnormal in it. There had been invested, in the course of the year, about £50,000, and on this they had not had a full year's interest; so that it made the amount that appeared—£5930—less than they might reasonably expect from investments made at the present time or during the year before. The reserve fund investment brought in, for the twelve months, about 3½ per cent.; and those investments that had been made in various gas and other undertakings yielded for the twelve months about 4 per cent.—that was to say, the present year's accounts, in interest, showed about £835 less than they would have exhibited if the whole twelve months' return had been received, or had become due. On the other side of the account was the figure for amortization. It was a figure that had gone on from year to year, and was on the principle of writing off the whole of the capital cost of the two stations that belonged to the Company—Messina and Montargis—by the end of their respective concessions. Up to the present time, over £50,000 had been written off in this way from the total capital cost of the works at Messina.

A POLITIC ATTITUDE AND A STRANGE CLAIM.

These works must have engaged the attention of the proprietors since they had had the report and accounts in their possession, because he was sure, to the minds of the proprietors, it was not quite a satisfactory position to see that a large town like Messina should owe the Company £30,961 of arrears for gas that should be paid for regularly, and, according to the custom in most of their cities, monthly or quarterly. Everything had been done by the Board that it was politic to do to get in this money. He did not think the Directors looked upon it for one moment as a bad debt; and the proprietors must see clearly that it was a wise thing, in dealing with a foreign municipality, to show them all the consideration they reasonably could. If they could not get payment at the time, and the Municipality gave them to understand that an arrangement would be made to pay the amount owing, it was not a wise thing to be in too great a hurry to put pressure on them. Then again, the proprietors knew that the Company's concession would terminate, and the conditions were rather onerous on the Company, when it terminated, with regard to the property. It was therefore very desirable the Company should be in as strong a position as possible when the right time came to negotiate for a continuation of the concession. The Municipality had also put forward a claim against the Company, and that claim was at present under arbitration in Rome. The Directors had no secrets from the proprietors; and he was going to read a clause from the concession bearing upon this claim. There was, he might mention, no specific amount involved at present. When he had read the clause he would not discuss the matter further, because, as it was under arbitration, it was not desirable, at a public meeting, that there should be any discussion of the merits or demerits of the claim. The article in question was the seventh of the concession; and it was worded thus:

> Whenever, in consequence of any progress in Science, the Municipality judges it necessary to impose on the Company any process different to its system of gas manufacture, the Company must conform to the Municipality's orders, if, by so doing, greater economy can be realized. In this case, the contracting Company must make over, in favour of the public and private lighting, one-half of the realized economy. This also applies in the case of the Company adopting of its own accord, and without the intervention of the town, a new process of manufacture. The town, however, has no right to impose on the Company a different system from its system of gas manufacture, unless the said new process shall have been adopted in one of the principal cities of Europe—that is to say, in a city having over 100,000 inhabitants.

That was the question the arbitrators would have to decide upon.

THE YEAR'S PROFITS.

The proprietors would see that the profit for the past twelve months amounted to £67,755, or about £5032 more than the net balance of profit of the preceding year. They had also no doubt observed that there was a small increase in the dividend received from the Union des Gaz; and he daresay they had thought it a very heavy sum that had been deducted for French and English tax from the amount actually received. The effect of these two taxes—the English income-tax, and the French tax—was to lessen the dividends received by nearly 1 per cent. Now the amount that was received from the French Company was the principal figure in the revenue account; and it was easy to see that the Company's income depended in the main upon the amount received from the Union des Gaz. When this concern prospered, it meant prosperity to their own Company. Fortunately, the Union des Gaz was prosperous; and the year that had passed had been, on the whole, a very favourable one.

LARGE CONSUMPTIONS AND EXTENSIONS.

The startling point was the enormous increase in the consumption of gas. The sales had augmented during the year by 300 million cubic feet, or equal to 9 per cent. And when they turned to some of the cities—Nanterre and Strasbourg, and especially Genoa and Milan—the percentage increase had been in excess of the figure named. The Union des Gaz had mainly to deal at present with the increase at Milan and Genoa, because while other cities required extensions, these two cities required new works. The increase in these two cities during the past ten years amounted to no less than 1300 million cubic feet. Hence, the increased revenue of the Company, even with the lower prices charged for gas in some of the cities, amounted to no less than £448,300. Money had been freely spent during these ten years in extending the works in the various cities; and up to a certain date, the money was always provided by the French Company in the form of obligations. He thought the proprietors would understand what an "obligation" was; but they might not quite realize that the French law involved the extinction of these obligations; and a large sum of money—a sum amounting last year to £100,000—was provided every year now, and would still have to be provided, partly for interest on the obligations, and partly to extinguish them. The amount each year to be charged was the same; but the interest constantly diminished, and the amortization constantly increased. The result was that, as they advanced towards the last years' run on the obligations, the interest would be very small, but the amount of amortization would be very large. Practically, for a number of years, all extensions had been paid for by the money received for these obligations; and the upshot would be that the works would have been paid for wholly out of revenue. That was the effect of the arrangement of amortization. To the French Directors, as well as to the Continental Union Directors, this amount having reached a large sum, it was considered that the ordinary share capital of the Company should be broadened; and so at the meeting in Paris in October last, it was decided that the money required for the entirely new works that were at present being constructed, and for the payment of the land, at Bovisa (Milan) and at Gavette (Genoa) should be provided in that form.

THE CREDIT OF THE UNION DES GAZ.

It was so common for men to be wise after the event, and it was a desirable thing to find men who were wise before the event, that he should like to be allowed to read an extract from the Chairman's speech twelve months ago. Mr. Lucas said:

> He must ask the proprietors to bear in mind that all these purchases of land, these extensions of works, and the obtaining of new concessions involved a corresponding increase of capital expenditure—an immediate expenditure, and one that would continue for some time to come. But, on the other hand, the Directors were perfectly justified in believing that the increase in the profits of the Union des Gaz would cover the larger amount of interest to be paid on the sums which would have to be raised to pay for all this work. How the money would be obtained, he was that day not prepared to say. But he had not much doubt that, considering the excellent credit the Company enjoyed in France, there would be little difficulty in raising the necessary capital.

On this point, Mr. Lucas was absolutely right, as he generally was in all his remarks. The French Company decided to issue 20,000 shares of £20 each at the price of £28—that was to say, a premium of £8 on every £20 share. Of course, the Continental Union Company had a right to a large number of the shares if they had exercised their right to the full; but, apart from their own, applications came from no less than 3725 people for 40,660 shares. It was a wonderful success. So far as the Company were concerned, they applied for 4000 shares at the same price as others had to pay; and they might have found themselves in the position, had the issue not been successful, of having to take up a very large number of the shares, because, by the French law—and it was a good law—whenever an issue was made, the whole of the shares must be subscribed for. There is another example he should like to see copied in England—that was, that a notary had to certify that all the deposit or premium, or whatever was arranged, was paid, and to let every shareholder, if he had only applied for one share, see the list of all the subscribers. To such an extent did the French people take an interest in small matters, that the average applications of the whole of the 3725 shareholders was eleven shares. That was the strength of France—the thrifty habits of the people, and the desire they always had to find channels where their investments might be safe according to their own judgment.

THE NEW WORKS AT MILAN AND GENOA.

He must now go back to the step they took before they had this money—that was, when the land was bought at Bovisa and Gavette. The works were designed, and were now being constructed. The works were modern, and intended to be worked economically. Their colleague, Mr. A. F. Phillips, was responsible for the design and the construction. As the proprietors knew, Mr. Phillips was a Director of the Continental Union Company, but not of the Union des Gaz; but the administrators of the Union des Gaz unanimously appointed him Consulting Engineer to that Company. The Board thought the satisfaction that would be felt by the proprietors would be as great as the satisfaction every one of the Directors felt on his appointment as Consulting Engineer. They had been associated on the Board with Mr. Phillips now for some time; and he could honestly say he had never in any business whatever met with a man possessed of more sleepless energy. Mr. Phillips would excuse him for saying (he would not talk of his ability for he, the Chairman, had not much technical knowledge, but he had a good knowledge of men) that he had great tact; and it was easy to get along with him—the one thing he (the Chairman) feared for originally if they had too clever an engineer on the Board.

FURTHER FINANCIAL EXPLANATION.

Now with regard to the new shares and the extensions, he should like the proprietors to realize first of all how the Continental Union Company were affected, and then the Union des Gaz. In taking these 4000 shares, the Board had the intense satisfaction of knowing they would not have to go to the proprietors for any money. The nightmare that came to the Board was that they might have to go to the proprietors with a debenture stock. He was thankful to say they had, in their investments, quite enough to pay for these shares; and it would also be seen that they made a considerable gain in interest. They would

be receiving interest at the rate of 6½ per cent., instead of a little less than the 4 per cent. they were obtaining at present from their investments. The 4000 shares, by the terms of issue, would have to be free from the premium; and the first instalment, or first call, made was (with the premium) £13; and therefore, on 4000 shares, they would have to find by Jan. 15 £52,000. Again by French law they would receive on the £52,000 dividend at the rate of the dividend that was paid or would be paid for twelve months to June 30 next—viz., at the average of the whole year. He took the net dividend paid during the present year as a little over 8 per cent., and for the half year to June 30, 1907, 4 per cent. on the whole amount (which was £80,000) came to £3200. But then, by the French law, there had to be deducted from this sum 2½ per cent. on the uncalled capital. This reduced it to £1700 for the half year; and this was a return for the half year of a little over 3¼ per cent. Therefore, so far as the Continental Union Company were concerned, the accounts would show an improvement next year. At any rate, so far as the Board could judge, the dividend would not be diminished during the time. As a matter of account-keeping, it must be credited for the half year, although it would not be paid until January, 1908. This was how it affected the Continental Union Company; and he thought the proprietors would see it affected them in a very satisfactory way. When he told them that it was not at all likely that the dividend would be less, he did not hold out the expectation that it would be more; but he did most emphatically say it was exceedingly unlikely to be less. When they considered that the French Company, in addition to extinguishing £36,000 of its obligations, carried another £12,000 to provide, as they had done for a number of years, against depreciation, and carried £40,000 to different reserves, besides paying the dividend, he thought the proprierors would agree that the position was immensely strong, and there was little chance of it being less in the coming year. So far as the French Company were concerned, they had to provide for the full rate of dividend on £400,000 of new capital—that was to say they had to provide for one half year on that amount, which was £18,000. But then the Union des Gaz got the benefit of 2½ per cent. over the half year on the whole £300,000 that was not called up. Therefore, the largest charge to be met would be £10,500 for the half year. But, on the other side, the moneys would have to be paid by the 15th of January would amount to £260,000; and, however largely the Engineer might sign certificates, he would leave a large balance that would be bearing interest. The Continental Union Company would now hold the nominal amount of £817,000 in the Union des Gaz, or a little more than the whole of the ordinary capital; and the cost value of the holding was only £849,000, or less than £21 a share. Now if the people of Paris and the country people came forward with eagerness to take up shares at £28, and which had some little disadvantages until they were fully paid, the proprietors of this Company might consider they had a very fine investment in the Union des Gaz.

Mr. N. E. B. Garey seconded the motion.

Mr. Cave Orme expressed sorrow that Mr. Lucas was unable to be present at the meeting. While he congratulated the Directors on the encouraging report, the congratulation was not untinged with regret that the Directors had not been able to recommend a slight rise in the dividend. However, on examining the accounts of the Union des Gaz, he found this comfort—that last year the increase in the quantity of gas sold was 9 per cent., but the increase in the net profits at the different stations had actually been 20 per cent. He should like to have the assurance of the Chairman that nothing had occurred, or was likely to occur, to depress this buoyant state of affairs. Regarding the stations of the Continental Union Company, he said that the profits at Messina and Montargis were placed at £8474; but in the general balance-sheet, there was the item "Messina town arrears, £30,961." On comparing this report with the last one, he saw that the Messina town arrears had increased by £6200; and it appeared to him that the £6200 was included in the £8474. He also inquired whether it was likely, when the Messina debt was paid off, that it would be in cash or bonds. He was delighted, as everyone must be, at the appointment of Mr. Phillips as a Director of the Company, though he had not yet been of the Union des Gaz. He (Mr. Cave Orme) understood that the contract with the Municipality of Milan would expire within a very few years; and yet the Company were going into a large expenditure at Bovisa. What guarantee had they that the Municipality would not leave them in the lurch?

Mr. Walter Hunter also congratulated the Board on having elected Mr. Phillips as a Director of the Company, and as the Consulting Engineer of the Union des Gaz. He (Mr. Hunter) had been to the works at Genoa, and was glad indeed that the new ones were being planned by a gentleman who knew so much about gas making as Mr. Phillips. It would have been a great deal better for the Directors and the Company if they had had similar advice before.

Mr. I. A. Crookenden thought it would have been a further matter for congratulation if Mr. Phillips had been elected on the Board of the Union des Gaz. But the Union des Gaz had, at any rate, been wise to secure his services in another position. In his (Mr. Crookenden's) opinion, however, Mr. Phillips should be endowed with even greater responsibility. He also asked how the Company stood with regard to the leases of their own two works, which appeared to be like two white elephants. Would it not be a good thing, as one of the towns was in deep debt to the Company, to suggest a transfer of the undertaking as it now stood? They would at any rate save the capital value at the end of the concession. The same thing might apply to the other concern.

Mr. H. D. Ellis, referring to the new issue of shares by the Union des Gaz, said he understood they were £20 (500 fr.) shares, and that they were issued at £28. What was about the market quotation at the present time?

The Chairman, in the course of his reply, said the Messina works, according to the terms of the concession, would eventually pass to the town of Messina. But it might be desirable for the town to have a modified concession; and he thought the fact that a town owed money rather helped a negotiator. Mr. Cave Orme had asked whether there were any skeletons in the cupboard. His answer was that there were not so many as they had had in former years. He did not think the men, who had great advantages, would be unreasonable enough to go beyond agitation. So far as Milan was concerned, things were in a much better state. But at Genoa, there were men who were turbulent, unreasonable, and very far from industrious. The Directors dealt with them in a kindly spirit; but there was one essential condition they would not move from, and that was they would have better work. But when every kindly allowance had been made for the conditions under which the men worked, the distressing thing was that the men would go on the principle of ca' canny. As to the interesting suggestion that they should pay a higher dividend, it must be remembered that they had to pay twelve instead of six months' interest on £60,000; and this had made a big hole in their £5000 increase. Last year they had to draw a little on their reserves to pay the 6½ per cent.; but this year, on the contrary, they increased the balance carried forward by £2456. He himself would like a bigger dividend. He could make no promises for next year; but no shareholder would be more disappointed than he if they did not get 7 per cent., though among his colleagues this was a controversial matter. Regarding Mr. Phillips, there was no doubt that he would go on the Board of the Union des Gaz when there was a vacancy. As to the market price of the shares, the first series stood at £33; and the second series at 32⅜. As to the concessions, that at Milan would end in 1925; Genoa in 1924; Nanterre and Rueil in 1940; and Strasbourg in 1932. With regard to the erection of the new works at Milan, it must be remembered that at the end of the concession, the Company only gave up the mains on certain terms—the works and the land still belonged to them. They could hardly conceive that there were many municipalities in Europe like the Municipality of Vienna, who would not—he was nearly saying out of spite or ill-feeling—buy the Vienna works of the Imperial Continental Gas Association. They were bound to erect the works at Milan and Genoa on account of the increase of business. They were good works; and he thought at the end of the concession, if it was not prolonged, the Municipality would be pleased to buy them. The Company's policy was to buy land; because it would be very difficult in a number of years to find land conveniently situated to their mains.

A dividend at the rate of 7 per cent. on the preference stock, less income-tax, and of 6½ per cent. on the ordinary stock, free of income-tax, was declared.

The Chairman proposed the re-election of the retiring Directors (Mr. R. S. Gardiner and Mr. J. H. Birchenough, C.M.G.). He referred to the great services rendered to the Company by both these experienced Directors in gas affairs.

Mr. R. Hesketh Jones seconded the motion, which was unanimously carried.

Acknowledgment of the re-elections having been made,

The Auditors (Messrs. A. T. Eastman and C. P. Crookenden) were unanimously re-appointed, on the motion of Mr. B. F. Harris, seconded by Mr. Walter Hunter.

THE NEW POLICY AT THE WORKS.

The Chairman moved a hearty vote of thanks to the Secretary in London (Mr. Martin), the Secretary in Paris (M. de Savignac), M. Lacombe, their Agent-General in Italy, and the managers and engineers, and staffs generally of the Company and of the Union des Gaz. Speaking of M. Lacombe, the Chairman said that his was one of the names that must be cherished in connection with the Union des Gaz. If the Company were now going on a better course, and if they were to make way with all the present difficulties ahead of them, it would be due to the strenuous efforts the Board had made to get a more experienced class of carbonizers, and, if anything, more powerful men at the head of affairs than they had hitherto had. If there was any fault to be found with Mr. Garey and himself, it was that they had held a little bit too tightly to the men they knew in former days. The difficulties were so great that they must have first-rate technical men for the carbonizing, and especially at the great stations. M. Lacombe was a first-rate man in every way, both for negotiation and management; and it was most fortunate they had got his services.

Mr. Birchenough seconded the motion, and he also spoke in high encomiums of M. Lacombe, who, he said, was to have complete control of the Italian stations. He described him as a man of great courage, of great steadfastness of character, a born negotiator, and a hard and devoted worker. The Board felt remarkable satisfaction that they had secured a man who had taken off their shoulders so much of the detail work, and on whom they could rely to relieve them of so much anxiety; and also to give in future great satisfaction to the proprietors, who had shown much patience with their Board during the last few years. They had also Managers at the other stations who would—partly on their own merits, and partly stimulated by the example of M. Lacombe—work loyally. Having visited most of the Company's stations since the last meeting—and some of the large ones several times—he (Mr. Birchenough) had intense satisfaction in asking the proprietors to pass this vote with great cordiality.

This having been done,

The Secretary briefly responded for himself and his colleagues in London and abroad.

Proposed by Mr. E. A. Goulding, and seconded by Mr. Cave Orme, a hearty vote of thanks was passed to the Chairman and Directors.

The Chairman, having acknowledged the vote on behalf of himself and his colleagues, said he hoped the proprietors would express the sympathy they had with Mr. Lucas, distinct from any other vote.

Mr. Walter Hunter moved a resolution, recognizing the great ability Mr. Lucas had shown as Chairman of the Company, and expressing the sympathy of the proprietors, and their hope that he would soon be restored to health and strength.

Mr. Harris seconded the motion; and it was heartily passed.

This concluded the proceedings.

Reduction in Price at Abertillery.—The Abertillery Urban District Council have resolved to make a reduction of 6d. per 1000 cubic feet in the charge for gas for lighting purposes—to take effect from April 1 next. It is stated that this concession will represent about £700 per annum; but the gas-works last year made a profit of £2000.

THE NEW WATER-WORKS FOR SELBY.

In the "JOURNAL" for the 10th of April last, we noticed the commencement of the works which are being carried out by the Urban District Council of Selby, at a cost of about £30,000, for furnishing the district with a more adequate supply of water. We learn that they are rapidly approaching completion—the machinery now being put into position. The works are situated on land purchased from the Lord of the Manor of Selby (the Earl of Londesborough), some two miles south-west of the town. They comprise engine and boiler houses, 30 feet by 30 feet, coal-store, and workshop. The buildings are of red brick, with stone facings, and the architecture is of mixed Grecian style. There are two towers, immediately underneath which are the pumps and boreholes; the latter being 400 feet in depth. The pumps, engines, and boilers are duplicated, and the engines will each be capable of pumping 750,000 gallons of water per day. The buildings stand at the foot of Brayton Barff, at the top of which is placed the reservoir, which covers an acre of land, and has a holding capacity of 800,000 gallons. It is 150 feet above the level of Selby, and 170 feet above Ordnance datum. The supply of water, which is practically unlimited, and, according to analysis, is of excellent quality, is to be pumped into the reservoir, and then it will be conveyed to Selby by gravitation. The pressure in the mains in the town of Selby will be a little more than 60 lbs. per square inch. In addition to the new supply, the present system is retained; the holding capacity of the old tower in Ousegate being 146,000 gallons. The new scheme has been carried out by Mr. Percy Griffith, M.Inst.C.E., and Mr. R. Bruce M'Gregor Gray, Assoc.M.Inst.C.E., the Surveyor to the District Council; the Contractors being Messrs. Parker and Sharpe, of York. There seems every probability of the work being completed early next year.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

When, in 1904, the Corporation of Airdrie took over the undertaking of the local Gas Company, the event was so quietly gone about that few outside the burgh were aware of it. As soon as the transfer took place, the Corporation set about the necessary extensions. These have produced a wonderful transformation upon the works, the capacity of which has been almost doubled. Now that the scheme of extensions recommended by Mr. David Vass, the Manager, has been all but carried out, the hearts of the Corporation have warmed to their latest acquired asset; and to mark their sense of joy at the successful completion of all the important parts of a task which looked formidable, they invited a few friends, and held a subdued revel on Thursday. They have good reason to be proud of their works now, for they both look well and have proved to be a profitable investment. Barring that they are a little crowded, and that the purifier accommodation is on the small side, there is nothing to prevent the works going on in their present condition for a number of years sufficient to bring down the capital account to a point at which it will be possible to view further outlay with equanimity, always granted that they remain under the careful and enlightened management which Mr. Vass bestows upon them. It is a pleasure to observe how he is appreciated by the Gas Committee, who, in turn, are led by their Convener—Mr. John Orr—with an intelligence and a singleness of purpose which are beyond all praise. The present extensions have been very cheaply procured; and when the time for further extensions arrives, they should not be costly either, because there is abundance of land already held upon which to erect them. When it is mentioned that the works which have been completed have been advised by Messrs. A. Gillespie and Son, of Glasgow, it will be realized that nothing has been left undone or unthought of, not even the smallest details, which would go to the provision of plant substantial, reliable, and safe to work. [A description of the works will be found on page 804.]

The members of the Eastern District of the Scottish Junior Gas Association must feel themselves highly honoured by to-day's proceedings. Their reception at the meter-works of Messrs. Alder and Mackay, of Edinburgh, was on a scale of cordiality such as they have not yet experienced. In their desire to be of service to the Association, the firm urged that the visit should take place in the forenoon, when the works would be going. This was partly accomplished; and the members who were able to attend were shown every one of the multifarious processes in the extensive New Grange Works. But for those who could not attend in the forenoon, the works were kept specially open in the afternoon; and the later visitors viewed them, though only as a study in still life. From half-past eleven till five, the works were at the call of the members of the Association; and then two hours more were spent in entertainment and enjoyment. Instruction blended with cheerfulness secured the happiness of all; and there was a cordial expression of gratitude to Messrs. Alder and Mackay for the opening of their works to the Association, and to the assistants of the firm for so ungrudgingly placing their services for the whole of a Saturday afternoon at the disposal of the Juniors.

The Lord Provost's Committee of the Edinburgh Town Council have appointed a Sub-Committee to consider and inquire into the whole question of the quality of the gas manufactured at the Granton Gas-Works. This was done upon the motion of Lord Provost Gibson, who said he considered that the matter was one of the greatest importance. The subject came before his Lordship's Committee by remit from the Town Council of a letter from the Clerk to the Gas Commissioners, explaining how the illuminating power of the gas was found to be lower than it should have been when tested on Oct. 8. The explanation was given at the last meeting of the Commissioners.

In the Glasgow Town Council last week, Mr. Maclure asked the Convener of the Gas Commissioners if there was any truth in the statements made in a letter in the "Glasgow Herald" of the previous Monday, headed "Mismanaged Coal Contracts," to the effect: (1) That after the final tenders for coal were put in, every effort was made to get reductions from individual tenderers; (2) that the Committee were only able to contract for a supply for six months, instead of for the usual period of one year; and (3) that they will have to pay for the second half year 2s. or 3s. a ton more than if they had got a year's supply as usual. Mr. T. Calderwood, the Convener, characterized the letter as one of those frequently written to the papers by men

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 801.

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Oct. 12	10½	Alliance & Dublin 10 p.c.	20–21	..	5 0 0
245,112	10	,,	7½	Do. 7 p.c.	14–15	..	5 0 0
200,000	5	Nov. 14	7	Bombay, Ltd.	6½–7	..	5 0 0
40,000	5	,,	7	Do. New, £4 paid	5–5½	..	5 1 10
50,000	10	Aug. 30	14	Bourne- & mouth Gas & and Water	10 p.c.	28–29	.. 4 16 7
51,810	10	,,	7		B 7 p.c.	17–17½	.. 4 0 0
53,200	10	,,	6		Pref. 6 p.c.	15–16	.. 3 15 0
380,000	Stk.	Aug. 15	12½	Brentford Consolidated		260–265	.. 4 14 4
300,000	,,	,,	9½	Do. New		200–205	.. 4 12 8
50,000	,,	,,	5	Do. 5 p.c. Pref.		120–125	.. 4 0 0
206,250	,,	Dec. 13	4	Do. 4 p.c. Deb.		101–104*	.. 3 16 11
220,000	Stk.	Sept. 27	11½	Brighton & Hove Orig.		230–235	.. 4 15 8
246,320	,,	,,	8½	Do. A. Ord. Stk.		163–168	.. 4 18 3
460,000	20	Sept. 27	10	British		41–42	.. 4 15 3
104,000	Stk.	Aug. 15	6	Bromley, Ord. 5 p.c.		121–125	.. 4 16 0
165,700	,,	,,	4½	Do. do. 3½ p.c.		91–94	.. 4 15 9
500,000	10	Oct. 12	7	Buenos Ayres (New) Ltd.		11½–12	.. 5 16 8
250,000	Stk.	Dec. 13	4	Do. 4 p.c. Deb.		94–96*	.. 4 3 4
150,000	20	July 12	8½	Cagliari, Ltd.		24–26	.. 6 6 11
100,000	10	Sept. 27	10	Cape Town & Dis., Ltd.		14–15	.. 6 13 4
100,000	10	Oct. 26	4½	Do. 4½ p.c Pref.		9½–10	.. 4 10 0
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.		50–52	.. 5 15 5
50,000	Stk.	June 28	4½	Do. 4½ p.c. Deb. Stk.		98–100	.. 4 10 0
157,150	Stk.	Aug. 15	5	Chester 5 p.c. Ord.		108½–110½	.. 4 10 6
1,443,280	Stk.	Aug. 30	5⅛	Commercial 4 p.c Stk.		110–113	.. 4 12 0
560,000	,,	,,	5	Do. 3½ p.c. do.		107–110	.. 4 10 11
475,000	,,	Dec. 13	3	Do. 3 p.c. Deb. Stk.		83–85*	+1 3 10 7
800,000	Stk.	,,	6½	Continental Union, Ltd.		124–127*	.. 5 2 4
200,000	,,	,,	7	Do. 7 p.c. Pref.		138–143*	+1½ 4 17 11
432,070	Stk.	Aug.	5½	Derby Con. Stk.		122–124	.. 4 8 9
55,000	,,	July	4	Do. Deb. Stk.		105–107	.. 3 14 9
486,090	10	July 27	11	European, Ltd.		24⅜–25⅜	.. 4 6 3
354,060	10	,,	11	Do. £7 10s. paid		18–19	.. 4 6 10
15,203,110	Stk.	Aug. 15	4⅘	Gas- & light & Coke	4 p.c. Ord.	98–99	.. 4 8 11
2,600,000	,,	,,	3½		3½ p.c. max.	88–90	.. 3 17 9
3,799,735	,,	,,	4		4 p.c. Con. Pref.	107–110	.. 3 12 9
4,193,975	,,	Dec. 13	3		3 p.c. Con. Deb.	84–86*	+1 3 9 9
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.		98–103	.. 4 17 1
8 2,500	,,	,,	6½	Do. do. 5 p.c.		118–121	.. 5 7 5
70,000	10	Oct. 12	11	Hongkong & China, Ltd.		19¼–20½	.. 5 7 4
4,940,000	Stk.	Nov. 14	8	Imperial Continental		177–180	−1 4 8 11
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.		95–97	.. 3 12 2
183,242	Stk.	Aug. 30	6	Lea Bridge Ord. 5 p.c.		120–125	.. 4 16 0
306,083	,,	June 28	4	L'rpool Unit'd Deb. Stk.		110–112	.. 3 11 5
561,000	Stk.	Aug. 30	10	Liverpool United A		229–231	.. 4 6 7
718,100	,,	,,	7	Do. B		168–169	−1 4 2 10
144,140	Stk.	Sept. 13	7⅞	Maidstone 5 p.c.		145–150	.. 5 1 8
75,000	5	Nov. 29	5	Malta & Medn., Ltd.		4¼–4½	.. 5 5 3
560,000	100	Oct. 1	5	Met. of & Melbourne & Deb.	5 p.c. Deb.	101–103	.. 4 17 1
250,000	100	,,	4½		4½ p.c. Deb.	100–102	.. 4 8 3
541,920	20	Nov. 14	3⅜	Monte Video, Ltd.		11½–12½	.. 5 12 0
1,675,892	Stk.	Aug. 15	4⅝	Newc'tle & G'tesh'd Con.		111½–112½	.. 4 2 3
406,025	Stk.	June 29	3½	Do. 3½ p.c. Deb.		98–99	−⅛ 3 10 8
15,000	10	Aug. 30	10	North Middlesex 10 p.c.		20–21	.. 4 15 3
55,940	10	,,	7	Do. 7 p.c.		13½–14½	.. 4 16 7
300,000	Stk.	Nov. 29	8	Oriental, Ltd.		150–155	.. 5 3 3
60,000	5	Sept. 13	7	Ottoman, Ltd.		5⅝–6⅞	.. 5 12 0
398,490	5	Oct. 26	7	Primitiva Ord.		7⅞–8	+¼ 4 7 6
796,980	5	July 27	5	Do. 5 p.c. Pref.		5⅛–5⅜	+⅛ 4 10 11
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.		94–96	.. 4 3 4
851,070	10	Oct. 12	7	River Plate Ord.		12¼–12⅝	.. 5 7 8
300,000	Stk.	June 28	4	Do. 4 p.c. Deb.		97–99	.. 4 0 10
250,000	10	Sept. 27	8	San Paulo, Ltd.		13¼–13⅜	−⅛ 5 16 5
70,000	50	July 2	5	Do. 5 p.c. Deb.		49–51	.. 4 18 0
135,000	Stk.	Sept. 13	10	Sheffield A		246–248	.. 4 0 8
209,984	,,	,,	10	Do. B		246–248	.. 4 0 8
523,500	,,	,,	10	Do. C		246–248	.. 4 0 8
70,000	10	Oct. 26	10	South African		15½–16½	.. 6 1 3
6,350,000	Stk.	Aug. 15	5½	South Met., 4 p.c. Ord.		128–130	.. 4 4 7
1,895,445	,,	July 12	3	Do. 3 p.c. Deb.		85–87	.. 3 9 0
201,720	Stk.	Sept. 13	8	South Shields Con. Stk.		156–158	.. 5 1 3
575,000	Stk.	Aug. 15	5⅜	S'th Suburb'n Ord. 5 p.c.		123–126	.. 4 7 4
60,000	,,	,,	5	Do. 5 p.c. Pref.		123–126	.. 3 19 4
112,533	,,	July 12	5	Do. 5 p.c. Deb. Stk.		128–133	.. 3 15 2
502,310	Stk.	Nov. 14	5	Southampton Ord.		105–110	.. 4 10 11
120,000	Stk.	Aug. 30	6⅔	Tottenham & and	A 5 p.c.	127–130	.. 5 0 0
388,020	,,	,,	5		B 3½ p.c.	104–106	.. 4 14 4
137,500	,,	June 28	4	Edmonton &	4 p.c. Deb.	103–105	.. 3 16 2
182,380	10	June 14	8	Tuscan, Ltd.		10¾–11½	+¼ 7 2 3
149,900	10	July 2	5	Do. 5 p.c. Deb. Red.		104–106	.. 4 14 4
193,742	Stk.	Sept. 13	5	Tynemouth 5 p.c. max.		106–108	.. 4 12 7
30,000	Stk.	Aug. 15	8	Wands- & worth & and	A 5 p.c.	—	.. —
255,636	,,	,,	6⅔		B 3½ p.c.	140–145	.. 4 9 8
75,000	,,	,,	5⅜		C 3½ p.c.	113–115	.. 4 17 6
79,416	,,	June 28	3	Putney & West Ham	3 p.c. Deb. Stk	82–85	.. 3 10 5
779,875	,,	Aug. 15	5⅛		5 p.c. Ord.	103–105	.. 4 17 3
185,000	,,	,,	5	Do. 5 p.c. Pref.		120–123	.. 4 1 4
193,300	,,	June 28	4	Do. 4 p.c. Deb. Stk.		103–106	.. 3 15 6

Prices marked * are "Ex div."

who knew nothing whatever of the matter they were writing about; and he was glad to have the opportunity of stating that there was no shadow of truth in the statements.

In the Lochgelly Town Council on Monday, Mr. M. Lee gave notice of motion to the effect that the Council should consider the advisability of their taking over the undertaking of the Lochgelly Gas Company, Limited. The question was raised at the recent municipal election, and excited some controversy. The capital of the Company is £10,000, having been recently increased to meet a large extension of the works. The annual make of gas is over 10 million cubic feet. The Company's undertaking has always been a profitable one. Since its formation in 1886, it has paid an average dividend of about 7 per cent. The £1 shares have sold as high as 27s. At the recent extension of capital, 100 shares were offered to consumers at a premium of 2s. 6d., and they were over applied for.

The Town Council of Dunfermline on Monday reduced the price of gas for all power purposes, and for use in bakers' hot-plates, from 2s. to 1s. 9d. per 1000 cubic feet. In June last, the price of gas for the same purposes, and also to the ordinary consumers, was lowered by 3d. per 1000 cubic feet.

I stated last week that the Sanquhar Town Council had acquired the undertaking of the local Gas Company, and were to take possession immediately. A difficulty has, however, arisen, in respect that the Council did not first adopt the Gas Acts. As this cannot be done until November of next year, the Council have arranged that the gas-works are to be taken over by Messrs. Forsyth and M'Crae, Solicitors, for one year; the Council to take possession then, and to make good any loss, if there should be any, which might be sustained during this period. The Council, however, made the appointment of Gas Manager as from the 4th prox.; the post being given to Mr. Callaghan, of the Corporation Gas-Works, Dumfries.

In a report to the Dumfries Corporation by Mr. G. Malam, the Gas Manager, as to the cost of gas cookers and grillers during the past ten years, it was shown that there had been a net return of 4½ per cent. upon the outlay. This was considered by some to be more than was necessary; and it was moved that the rents of these appliances be reduced. The Council, however, refused to pass the motion. A Committee was appointed to confer with the Gas Manager as to his report upon the erection of sulphate plant in the gas-works.

The Gas Committee of the Arbroath Town Council reported on Monday that they had considered an application by the labourers at the purifiers and in the coal-store for an increase of their wages, which were 4½d. per hour. On the recommendation of the Manager, the Committee agreed to increase their wages to 5d. per hour; and they further agreed to increase the wages of the men who attend to the boiler and the sulphate of ammonia plant to the extent of 1s. per week, making them 25s.; and that stokers' wages should be increased by ½d. per hour. The Committee were of opinion that the additional expense of hand stoking made it desirable that they should ascertain what saving, if any, might be effected by the introduction of mechanical stoking into the gas-works; and they remitted to the Manager to make a report to them on the subject. Bailie Smith moved approval of these recommendations, and the Council unanimously adopted them.

The Lighting Committee of the Hamilton Town Council reported on Tuesday to the Council that there had been complaints about smells from the gas, and, regarding these, Bailie Hamilton, the Convener of the Committee, said that he and the Gas Manager had gone to Kemp Street, and had found no smell of gas there, but a bad smell farther on, coming from a sewer. He was not aware that stuff from the gas-works was discharged into this sewer; but if it were, he would endeavour to have it remedied. Bailie Kay made complaint about noxious smells from the sulphate works. Bailie Hamilton said this was the first time he had heard this particular objection raised; and it would be attended to. Complaint having been made regarding the quality of the gas, Bailie Hamilton explained that during October it was of an average of 18·6 candles, but during November it was very much improved.

CURRENT SALES OF GAS PRODUCTS.

Week ending Dec. 15.

Sulphate of Ammonia. LIVERPOOL, *Dec.* 15.

There has been no recovery from the depression which settled upon the market in November; for, although there has been a fair amount of inquiry, buyers have not been very serious, and makers have only been able to effect sales at a further decline in prices. At the close, the quotation f.o.b. Hull cannot be put at over £11 16s. 3d. per ton, while £11 17s. 6d. to £11 18s. 9d. f.o.b Liverpool, and £12 per ton f.o.b. Leith, are the prices being quoted. There has been a considerable inquiry in the forward position, but the ideas of buyers are still very little above spot prices; and, while makers maintain their firm attitude, speculators hesitate to take much liberty with their prices, unless for near delivery. Consequently there has not been much actual business.

Nitrate of Soda.

This article remains quiet at 11s. 3d. per cwt. for 95 per cent., and 12s. per cwt. for refined quality, on spot.

Tar Products. LONDON, *Dec.* 15.

Markets have been quiet during the past week; and it is improbable that there will be much business doing now until after the holidays. Pitch is very weak for this season's delivery. It is just possible that some quantity of London pitch could be secured for prompt delivery at 26s.; while business has been done on the east coast at 24s. 6d. and 25s. per ton, though in the former case there was rather a high rate

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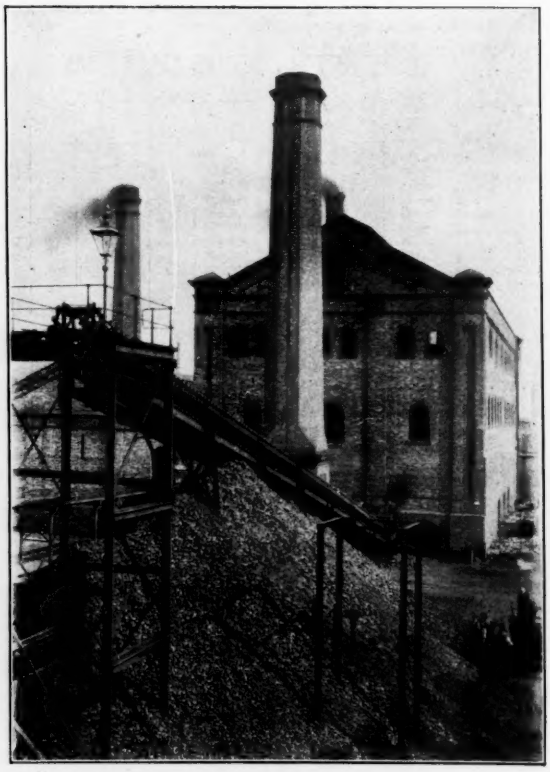

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NEW CONVEYOR CO., LTD., SMETHWICK.

of freight upon same. On the west coast, Manchester pitch has been offering at 25s. 6d. without finding buyers; while 25s. has been accepted at other places for January-March delivery. Continental consumers, and also those in South Wales, appear unwilling to purchase just at present. The market for creosote is firm. Some quantity of London oil could be secured at 2½d. But makers themselves are well sold, and do not care to quote; and the same applies to manufacturers in the Midlands and the North. The market for carbolic acid is quiet. Continental consumers now refuse to pay more than 1s. 8¾d. for prompt delivery, and 1s. 8½d. forward. In crystals, business is reported to have been done at rather better prices. Solvent naphtha is very firm, especially for prompt delivery, for which London manufacturers are somewhat behind with deliveries. Toluol remains unchanged; and no transactions of importance are reported. Benzol, 90 per cent., is very firm for prompt delivery; while good prices are being asked over the first few months of next year. Business is reported in anthracene at improved prices; but this is probably for specially fine makes.

The average values during the week were: Tar, 15s. 6d. to 19s. 6d. Pitch, London, 26s. 3d. to 26s. 6d.; east coast, 25s. to 25s. 6d.; west coast, 25s. Benzol, 90 per cent., 1s. to 1s. 1d.; 50-90 per cent., 11½d. to 1s. Toluol, 1s. 1½d. to 1s. 2d. Crude naphtha, 4¾d. to 5¼d.; solvent naphtha, 1s. 3d. to 1s. 5d.; heavy naphtha, 1s. 3d. to 1s. 5d. Creosote, London, 2⅛d. to 2¼d.; North, 1⅞d. to 2d. Heavy oils, 2½d. Carbolic acid, 60 per cent., 1s. 8¾d. to 1s. 9d. Naphthalene, £4 10s. to £9 10s.; salts, 32s. 6d. to 35s. Anthracene, "A" quality, 1½d. to 1⅝d.

Sulphate of Ammonia.

The market has been very quiet during the past week, and prices have receded about 2s. 6d. all round. In London, outside makes could probably be secured on Beckton terms for prompt delivery at £11 15s. to £11 17s. 6d.; while ordinary London terms are £11 17s. 6d. to £12. In Leith, second-hand parcels have been sold at £12 at the latter end of the week. In Liverpool, business is reported at £11 17s. 6d., but at better prices for forward. In Hull, no transactions are reported; but the price may be taken as £11 15s. to £11 17s. 6d. The market closes decidedly weak; and there does not appear to be much hope of its recovery before the New Year.

The tenth annual entertainment by the employees of the South African Lighting Association, in celebration of the King's Birthday, took place in the Town Hall, Port Elizabeth, on the 12th ult.—Mr. W. Arnott, the Manager, in the chair. A varied programme was gone through, including the exhibition of a number of beautiful lantern views of spots in the Homeland taken by Mr. Arnott; and in the interval between the parts, he availed himself of the opportunity of making a few remarks upon the relative merits of gas and electric lighting. Light refreshments were served, and a thoroughly enjoyable evening was spent.

COAL TRADE REPORTS.

Lancashire Coal Trade.

There is no change to report in the coal trade of the County Palatine. The pits everywhere are well employed; and the output has never been greater than at the present time. The wages question and the re-formation of the Coal Conciliation Board are not yet settled; but there is every hope that satisfactory arrangements will be arrived at between the masters and the men's representatives. Business in all sections of coal, coke, and cannel is brisk. There is no alteration to report in prices. The Chancellor of the Exchequer's estimate of £1,000,000 by the abolition of the coal-tax will not be realized. Instead of a million short, the loss will be only £650,700. The removal of the tax has benefited shippers, both in the quantity of coal exported and in the prices obtained for it. There is a scarcity of fuel throughout Germany.

Northern Coal Trade.

Though impeded a little by the delay of steamers, the coal trade in the North-east has been very active. There has been a heavy production at most of the collieries; and, with a strong demand, shipments have been full. In the steam coal trade, the certainty of the lessened output in the next two weeks has stiffened prices generally. Best Northumbrian steams are 12s. to 12s. 3d. per ton f.o.b., second-class steams about 11s., and steam smalls are steady at from 7s. to 8s. It is possible, however, that prices may ease a little when work is normal again. In the gas coal trade, the request is very heavy—at its highest point for the season; and, except where there is any delay from the cause stated above, the shipments are very full on the long contracts. There is also a demand for the best Durham gas coals. Prices vary from 10s. to 11s. 3d. per ton f.o.b.; but higher figures are asked for special kinds of gas coal. No contracts are reported of any extent in the last few days. The coke trade is very strong, and this benefits gas coke. The large output of gas coke, however, has given a little ease to its price and from 13s. to 13s. 6d. per ton f.o.b. is now the current quotation for good Tyneside gas coke.

Scotch Coal Trade.

Bad deliveries of coal are being complained of; the export trade taking up more than is considered its fair share of the output. The home trade is also strong, with the consequence that the collieries can scarcely keep up with the demand. Splint is reported to be scarce. The prices quoted are: Ell 10s. to 11s. 6d., splint 11s. 3d. to 11s. 6d., and steam 10s. to 10s. 3d. The shipments for the week amounted to 263,154 tons—a decrease of 15,315 tons upon the previous week, but an increase of 20,798 tons upon the same week of last year. For the year to date, the total shipments have been 13,114,848 tons, an increase of 1,409,741 tons upon the corresponding period of 1905.

RADIATOR PICTURES, No. 9.

Wright's
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The Perfected Method of Heating.

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Wright's "St. Andrew" Gas-Heated Steam Radiators are in use at the Rifle Drill Hall, Bristol.

The "Wickedness" of Street Lighting.

Our contemporary the "Ironmonger" calls attention, in the current issue, to the recent celebration of the eightieth anniversary of the date when gas-lamps were first employed to light the streets of Berlin, and to the reproduction, by the "Journal für Gasbeleuchtung," of an article published in March, 1819, by the leading Cologne newspaper, setting forth the arguments used in a pamphlet scattered broadcast among the people, wherein the author argued solemnly and strenuously against the adoption of any form of artificial light in the public streets. Objections to street lamps were taken by the writer on seven different grounds. In the first place, he declared that the illumination of the streets was wrong theologically, for it was an attempt to evade the law of God, who appointed darkness to follow light, and ordained the moon to shine at certain times only. Mortals had no right to criticize or interfere with the plans of the Deity, by turning night into day. Secondly, it was wrong, legally; for the cost of the lamps was an indirect tax, falling on people who did not require any light, and indeed found it an inconvenience, as well as upon those who liked it. Thirdly, it was wrong hygienically, for the fumes of the oil or gas would poison the air, and affect the health of delicate persons; while, by encouraging others to be abroad after dark, the light would assist in the spread of colds and similar affections. Fourthly, it was wrong morally and philosophically, for it would lower the standard of morality, and remove that fear of darkness which prevents many a weak-minded individual from plunging into crime. It would increase drunkenness, enabling the toper to remain in the public-house till late at night, and it would assist lovers. Fifthly, it was wrong from a police point of view, for the light would make horses shy and robbers bold. Sixthly, it was wrong politically, for the money spent on the light would go abroad, and so decrease the national wealth. Seventhly, it was wrong nationally, public fêtes illuminated by artificial light being potent factors in the growth of patriotism; whereas if the streets were lighted up every night, specially illuminated functions would lose their effect upon the imagination of the populace. Our contemporary remarks that the arguments seem to be very silly now, but are not more so than many that are employed daily with regard to reforms looking eighty years hence.

Gas Profits at Southport.—Moving the adoption by the Southport Town Council of the minutes of the Gas Committee, Alderman Travis said the profit for the six summer months was about equal to the same period of 1905. It was only during recent years that they had made any profit in the summer months. About 60,500,000 cubic feet more gas had been sold during the six months ending September last than during the same period in 1905, which was an increase of 3·37 per cent. He was glad to say that, so far as he could see, the result for the year in connection with the gas undertaking was likely to be one of the best they had had.

Damage to Lamp-Posts by Motor-Buses.

An action to test the liability of motor omnibus companies in respect of broken lamp-posts was brought at the Marylebone County Court, before Sir William Selfe, by the Metropolitan Railway Company, on Monday last week. Mr. C. Fitch, the plaintiffs' Counsel, said in view of the fact that thousands of lamp-posts had been knocked down in London since the motor-bus came into existence, his clients' action was of great general interest. The particular lamp-post in respect of which the claim was made was situated outside the Company's Edgware Road Station. Several witnesses were called to prove that one of the London Motor-Bus Company's "Vanguard" vehicles stopped to pick up passengers, and in restarting caused the accident. For the defence, it was contended that plaintiffs' witnesses were mistaken in thinking the night of the accident was fine and dry, and that the smash was in reality caused by the vehicle skidding on the greasy pavement. Mr. Eames, for the Omnibus Company, submitted that the defendants could not be held responsible for side-slip; but His Honour found for the plaintiffs. He said it seemed to him that the owners of those vehicles which damaged the lives and property of other people "should pay for it." The sooner the point of liability for skidding was decided in the High Courts the better. These motor-buses, added the Judge, were permitted on the streets while they were in an experimental state; and though regulations had been drawn up with regard to noise, smell, and vibration, nothing seemed to have been done with regard to the very much greater danger of skidding. If the evidence of negligence had not been sufficient for plaintiffs to succeed in the present case, he would have been prepared to find against the defendants on the ground of "nuisance"—for putting a conveyance on the public thoroughfares which was admittedly uncontrollable under certain conditions. There would be judgment for the plaintiffs for the amount claimed, with costs.

Advance in the Price of Gas Appliances.—Owing to the continued heavy increase in the cost of raw materials, circulars have been sent out by all the leading makers of gas cooking and heating apparatus, announcing the withdrawal of all unaccepted quotations, and an advance, as from the 12th inst., of 7½ per cent., which will be added to the net amount of the invoice. Copper goods, brass goods, and fittings are subject to an advance of 10 per cent., and in some cases will be invoiced *plus* 15 per cent.

Batley Water Supply.—The Batley Town Council have received a report from a Sub-Committee appointed to negotiate with the Halifax Corporation and the Dewsbury and Heckmondwike Water Board for a supply of water. Batley is now using all the water it can bring from its own reservoirs into the town, and an additional supply is needed. As a result of negotiations, this is to be obtained from the Dewsbury and Heckmondwike Board at the price of 6d. per 1000 gallons. The charge is higher than that offered by Halifax; but there will be a great saving in the cost of connecting the mains.

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

The Economical Gas Apparatus Construction Co., Ld.

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. TELEGRAPHIC ADDRESS: "CARBURETED, LONDON."

CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:—

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
Blackburn	1,250,000	Winnipeg, Man.	500,000	Malton	150,000
Windsor St. Works, Birmingham	2,000,000	Colchester (Second Contract)	300,000	Smethwick	500,000
Saltley Works, Birmingham	2,000,000	York	750,000	Gravesend	300,000
Colchester	300,000	Rochester	500,000	Pernambuco, Brazil	125,000
Birkenhead	2,250,000	Kingston, Ont.	300,000	Duluth, (Second Contract)	300,000
Devizes	120,000	Crystal Palace District	2,000,000	Leicester (Second Contract)	1,000,000
Saltley, Birmingham (Second Contract)	2,000,000	Duluth, Minn.	300,000	Newport (Second Contract)	250,000
Windsor St., Birmingham (Second Contract)	2,000,000	Caterham	150,000	Brockville	250,000
Halifax	1,000,000	Leicester	2,000,000	Toronto (Third Contract)	750,000
Toronto	250,000	Enschede, Holland	150,000	Montreal, Ont. (Second Con.)	1,800,000
Ottawa	250,000	Buenos Ayres (River Plate Co.)	700,000	Toronto (Fourth Contract)	1,000,000
Lindsay (Remodelled)	125,000	Burnley	1,500,000	Hamilton, Ont.	400,000
Montreal	500,000	Kingston-on-Thames	1,750,000	Rochester (Third Contract)	1,600,000
Toronto (2nd Cont., Remodelled)	2,000,000	Accrington	500,000	Leeds (Second Contract)	900,000
Belleville	250,000	Tonbridge	300,000	Buenos Ayres (Primitiva Co.)	1,200,000
Ottawa (Second Contract)	250,000	Stretford	500,000	Buenos Ayres (New Co.)	1,200,000
Brantford (Remodelled)	200,000	Oldbury	300,000	Christchurch, N.Z.	300,000
St. Catherines (Remodelled)	250,000	Todmorden	500,000	Rochdale	1,600,000
Kingston, Pa.	125,000	Saltley, Birmingham (Third Contract)	2,000,000	St. John's, Newfoundland	250,000
Peterborough, Ont.	250,000	York (Second Contract)	750,000	Brantford (Second Contract)	400,000
Wilkesbarre, Pa.	750,000	Rochester (Second Contract)	500,000	Smethwick (Second Contract)	500,000
St. Catherines (Second Cont.)	250,000	Newport (Mon.)	250,000	Pontypridd	250,000
Buffalo, N.Y.	2,000,000	Tokio, Japan	1,000,000	Montreal (Third Contract)	1,800,000
		Newcastle-on-Tyne	1,800,000	Guelph, Ont.	350,000
		Leeds	1,800,000	Buenos Ayres (River Plate Co.) Second Contract	750,000
				Belgrano (River Plate Co.)	500,000
				Quebec	250,000

And, in addition, COAL GAS PLANTS at NELSON, B.C., CHATHAM, BERLIN, NAPANEE, OWEN SOUND, CALGARY, and WINNIPEG.

Appointment of a Gas-Tester Resented at Blaenavon.

The Manager of the Blaenavon Gas-Works, Mr. Charles White, has for the past six years occupied the position of Chairman of the Blaenavon Urban District Council; but he has resigned that office now as the result of a resolution of the Council to have the gas tested and reported on by an independent inspector. A special meeting of the Council was held, when a letter was read from Mr. White, in which he stated that the resolution of the Council placed him in the category of suspected persons, who, if left unwatched, were supposed to be willing to defraud the public they were expected to honestly serve. Therefore he could not consistently continue to act as Chairman of the Council. Mr. T. Ruther, who presided, said Mr. White was the best Chairman they had had; and if he intended to retire from public life, it would be a very great loss to the community. He was sorry to think that through any action of theirs Mr. White had taken this step. The Council certainly did not doubt his honesty or integrity for one moment. A resolution was passed that the Council should ask Mr. White to reconsider his decision; and a deputation was elected to wait upon him. Several members said that, in passing the resolution, they were only carrying out the Act of Parliament; and there was no reflection on Mr. White. One member remarked that, though they did not doubt that Blaenavon gas was equal to what was demanded, yet as a Council they were doing their duty in deciding to have it tested.

Sales of Stocks and Shares.

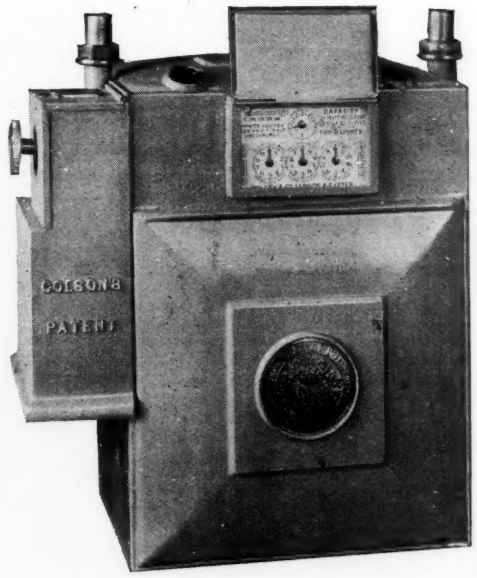
At the Mart, Tokenhouse Yard, E.C., last Tuesday, Mr. Alfred Richards offered for sale, by order of the Directors, £12,000 of consolidated ordinary stock of the Lea Bridge District Gas Company, ranking for a standard dividend of 5 per cent. per annum, subject to the sliding-scale; the dividend on existing similar stock having been at the rate of 6 per cent. for the last five years. It was all sold at from £120 to £122 10s. per £100 of stock, *cum div.* as from the 1st prox. The average was £120 9s. 1d., yielding £4 19s. 8d. on the investment. On the same occasion, Mr. Richards submitted for competition, by direction of a Trustee in bankruptcy, some £10 fully-paid shares in the West Hampshire Water Company, ranking for a maximum dividend of 7 per cent., but restricted to 1¼ per cent. until 5 per cent. is declared on the other ordinary shares. They were all sold at from £2 10s. to £3 15s. each. Next day, in accordance with the announcement which recently appeared in the "JOURNAL," a sale took place at the offices of the Derby Gas Company, by Mr. Cumberland (of the firm of Messrs. Cumberland, Brownson, and Page), of £10,000 of ordinary consolidated 5 per cent. stock of the Company, which, under the sliding-scale, is entitled to 5½ per cent., in accordance with their Act of 1903. The highest price obtained was £124 15s. for each £100, and the lowest £124; the average price being £124 6s. 6d., which yields the investor 4·43 per cent. There was a large attendance, and the hundred lots into which the stock was divided were all sold within a quarter-of-an-hour. It was one of the most successful sales the Company have had.

Reduction in Price.—The Directors of the Blyth and Cowpen Gas Company announce that after the reading of the meters which will take place this month the price of gas will be reduced from 3s. to 2s. 10d. per 1000 cubic feet, less 5 per cent. discount for payment on or before a date to be specified. To the prepayment meter consumers the Directors have decided to allow a reduction of 2d. per 1000 cubic feet on all accounts when the consumption reaches 1000 cubic feet and upwards during the quarter.

An East Westmorland Water Scheme.—The East Westmorland Rural District Council have been considering a proposed water scheme, with the Ravenstonedale Hills as the source of supply, for Brough and a number of other villages in the same neighbourhood. The estimated cost is £8500, which it is proposed to apportion over the several parishes benefiting by the scheme, on the basis of population and assessable value for sanitary purposes, as follows: Brough, £2714; Brough Sowerby, £686; Crosby Garrett, £1387; Musgrave, £1480; Soulby, £1396; and Waitby, £836. The Local Government Board are to be approached for sanction to the borrowing of the necessary capital; and the scheme will, it is expected, be proceeded with in the early spring.

The Water-Slide Chandelier Again.—At an inquest on the body of a retired baker who was, the Jury determined, asphyxiated by gas, Mr. Barrett, the Superintendent of the Fittings Department to the Birmingham Corporation, who was called upon to inspect the gas pipes and fittings in the house in which the fatality occurred, said he found that the pipes were sound, but that the fittings generally were very defective, allowing of escapes of gas. In the bed-room where deceased was discovered dead, Mr. Barrett found the slide-chandelier to be short of water; and, moreover, it had been habitually kept short of water. The Coroner, in summing-up, mentioned that with slide-chandeliers in connection with which water was used, a very good plan was to put a little castor oil on the top of the water, as evaporation was thus considerably retarded.

Villages in Darkness.—In a letter to the "Daily Telegraph," Mr. F. G. Heath, writing from Kew Gardens, calls attention to the unwise economy of many Parish Councils in villages in ordering the extinction of all lights after ten or eleven o'clock at night, when, residents being in bed, not the faintest glimmer from any private window is available to relieve the "cimmerian darkness" of public thoroughfares. He points out that during the numerous moonless, cloudy nights of winter the danger to public security is enormous, and a distinct temptation is offered to criminals of all kinds; and he says that to put one policeman with miles of beat to protect considerable areas under such circumstances is not only absurd, but is unfair to the police service. As extended lighting, to cover all periods of absolute darkness, would involve no extra labour, but only the expenditure of a little more gas or a little more oil—merely amounting, in many cases, to an extra shilling or two nightly—is not this, he asks, a question for the Home Secretary, or, if necessary, for a short Act of Parliament, making all-night lighting compulsory.



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Can be supplied Fitted to

THE "WILLEY" METER.

WILLEY & CO., Ltd., LONDON AND EXETER.

The New Gas-Works for Hathersage.—Owing, it is stated, to some mistake with regard to the ironwork for the gas-works at Hathersage, the plant will not be ready by the time it was expected. The laying of the mains has, however, been proceeded with; and Sickleholme and Bamford will shortly be reached. Many houses in Hathersage have been connected with the pipes.

Tees Valley Water Bill.—The Stockton Corporation have now withdrawn their opposition to the Tees Valley Water Bill; and this brings the three Authorities concerned into line. In order to keep pace with the requirements of the district, the Board find it absolutely necessary to secure an additional source of supply, pending the completion of their Grassholm reservoir; and the only place they can go to for this is, they maintain, the river.

Charge of Stealing Gas.—Last Wednesday, the Portsmouth Borough Justices committed for trial a refreshment-house keeper, named Gosling, who had been a customer of the Portsea Island Gas Company, but whose meter had been removed on account of the non-payment of his bill, on a charge of fraudulently consuming 2496 feet of gas, valued at 5s. 8d., by connecting the house service-pipe with the Company's main. The prisoner denied the accusation, and said the connection had been made by a lodger.

Ornamentation of Lamp-Posts.—The Warrington Gas Committee have decided to allow the "Beautiful Warrington" Society to place hanging baskets on certain of the lamp-posts on the following conditions: That the design of the basket be first approved by the Gas Engineer (Mr. W. S. Haddock). That the baskets are maintained in proper order by, and at the expense of, the Society. That the Society make good at their own expense any damage which may be caused by, or incidental to, the privilege hereby granted. That the baskets be removed when requested by the Committee.

Cost of Cooking a Dinner by Gas.—In connection with the cookery demonstrations given at the recent gas exhibition at Hereford, Mr. W. W. Townsend, the Gas Engineer and Manager, writes to a local paper stating that a meter was fixed on the gas supply to the cooker, so that the audience could see how much gas was used. From this it was ascertained that 50 cubic feet of gas had cooked the following dinner, sufficient for six persons, at a cost of 1½d.: Fried fillets of sole, tomatoes à la Piedmontaise, roast sirloin, brown potatoes, cauliflowers, sauce, mince pies, jam tarts, apricot pudding, cheese savoury.

Ongar Water Company's Amalgamation.—The Ongar Water Company have just held what will in all probability prove to be their last meeting; for the Herts and Essex Water-Works Company are to take over the undertaking on terms already agreed upon. The report stated that the revenue for the year to Sept. 30 last was £383; while there was an amount brought forward from the preceding twelve months of £308. After paying working expenses, &c., there was a balance on revenue of £169. A dividend at the rate of 5 per cent. was declared, leaving £158 to be carried forward. A vote of thanks was accorded to the Chairman (Mr. H. E. Jones) for his services to the Company.

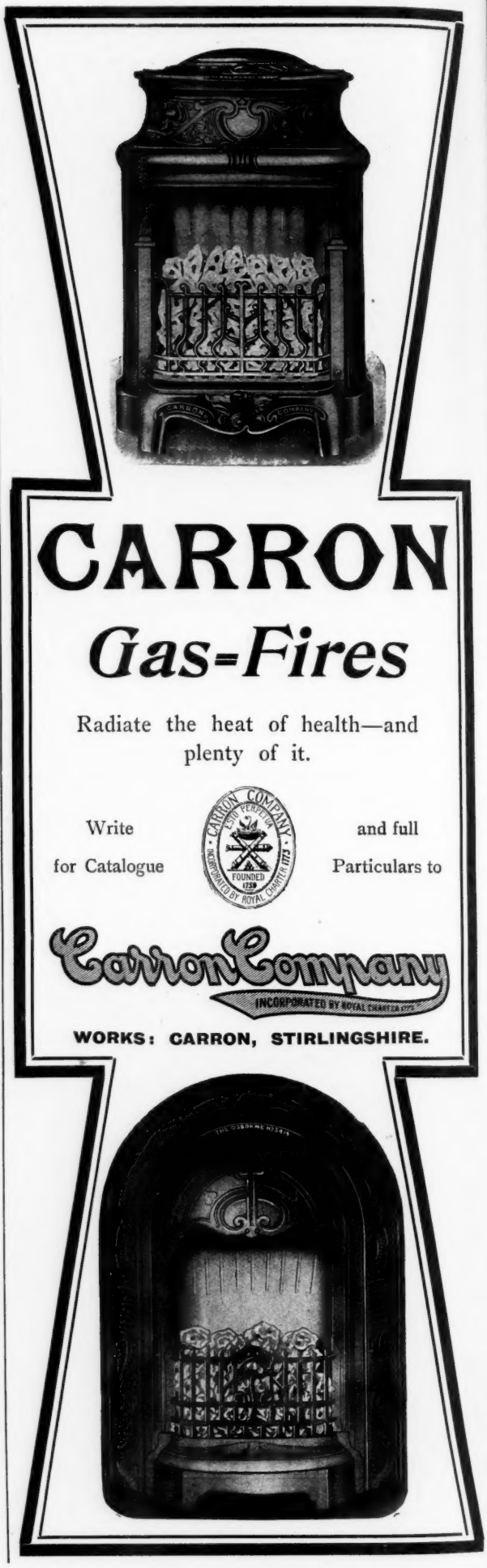
West Greenwich Gas-Works Institute.—The annual dinner of this Institute, which is situated upon the premises of the South Metropolitan Gas Company in Greenwich, was held last Saturday—Mr. J. F. Braidwood in the chair. The large company included Mr. H. Austin and Mr. C. T. Drumgold, two of the Directors. The Chairman, in proposing "The South Metropolitan Gas Company," dilated upon the benefits of the profit-sharing system introduced by Sir George Livesey, who, he said, was always doing his utmost to improve the position of the workers. Mr. Austin responded to the toast, and spoke in warm terms of the co-partnership scheme; saying their only regret was that it had not been longer in existence.

The Nuneaton Gas Company have arranged with the Richmond Gas Stove and Meter Company, Limited, to undertake the complete supply and fitting up of automatic installations in their district, including cooker, meter (George Glover's make), pendant, and brackets. The Richmond Company are also to thoroughly canvass the district to obtain orders. It is anticipated that some 2000 houses will be fitted.

About a year ago a reservoir which had been constructed for the supply of water to portions of Midsomer Norton and the surrounding parishes, on being filled with water, collapsed in such a manner that it was rendered useless. The authorities, however, were undaunted; and a new reservoir, of larger capacity and on improved plans, was at once commenced. But when it was finished, and nearly filled with water, it was found to be seriously leaking. The water was at once turned off, when it was discovered that a repetition of the first disaster had occurred. The reservoir was calculated to hold 600,000 gallons.

We have received from Mr. Walter Spencer, of Elland, a descriptive catalogue of his patent hurdle grid, to which several references have been made in the "JOURNAL." Views are given of the application of the grid to purifiers; and the structural advantages and practical results obtained by its use are fully set forth. The catalogue contains a number of testimonials from gas engineers in favour of the hurdle grid; and these are followed by Mr. Kendrick's paper read before the Manchester District Institution, with the remarks made thereon. The rest of the catalogue is occupied with particulars of the ordinary grids made by Mr. Spencer, as well as his boards for tower scrubbers.

The third annual dinner of the Tottenham and Edmonton Gas Company's Staff Cricket Club was held at the Red House, Tottenham, on Saturday, the 8th inst., and was attended by about 60 members and friends, the chair being occupied by Mr. A. E. Broadberry, the Company's Engineer and Manager, who was supported by Mr. James Randall (the Secretary), and Messrs. E. Topley and J. Terrace. The Chairman proposed "The Cricket Club" in a witty speech, to which Mr. R. C. Price, the Hon. Secretary of the Club, responded. In acknowledging the toast of "The Chairman," Mr. Broadberry said he wished to couple with it the name of Mr. J. Randall, who, if he was not level with him, was always trying to get in front, in matters appertaining to the benefit of the Company's staff. The prizes won during the past season were then distributed, and a varied musical programme was gone through.



The Douglas Gas Company have been approached by the Town Council to reduce the charge for public lighting and for gas used for cooking, heating, and power purposes.

An interim dividend of 6 per cent. per annum (less income-tax) has been declared on the preference shares of the Welsbach Incandescent Gaslight Company, for the six months ending Sept. 30.

The business of wrought-iron and steel tube manufacture carried on by the late Mr. Joseph Aird at Great Bridge, Staffordshire, will shortly be transferred to the Wellington Tube-Works, Limited, and be continued under this style.

Among the places where Messrs. John Wright and Co. have recently erected some of their gas steam radiators, may be mentioned the United Methodist Free Church and Christ Church, at Armley, near Leeds, and the Jewish Synagogue, at Bradford.

At the Teignmouth Police Court on Monday last week, Reginald Frank Poole, a tradesman of the town, pleaded "guilty" to burning a quantity of gas, the property of the Urban District Council, without its being registered. He was fined £5, and ordered to pay £2 for the gas used and 20s. costs.

A well-known quayside merchant was found dead in his office chair at Stockton-on-Tees one day last week; death having been due to asphyxiation by gas. The door was locked, and the gas-burner had been removed; while on the desk was a request that a relative at West Hartlepool should be telephoned to.

Having traced an escape of gas to the back sitting-room of his house, Mr. J. Conway, of South Shields, left the door open for four or five minutes. He then entered the room, and struck a match for the purpose of examining the chandelier. He was considerably scorched by the resultant explosion, and the building extensively damaged.

APPLICATIONS FOR LETTERS PATENT.

27,336.—Antcliff, H. R., "Prepayment meters." Dec. 1.
27,355.—Crossley, W. J., and Rigby, T., "Manufacture of producer gas." Dec. 1.
27,374.—Mannesmann, O., "Inverted burners." Dec. 1.
27,380.—Junkers, H., "Gas-stoves." Dec. 1.
27,428-9.—Nott, G., "Gas valves and cocks." Dec. 1.
27,431.—Lane, E. J., "Gas-exhauster, &c." Dec. 3.
27,442.—Sharp, R. N., Ingle, J. H., and Thornton, H., "Inverted burners." Dec. 3.
27,452.—Goddard, J. E., "Intensifying air regulator for gas incandescent lights." Dec. 3.
27,467.—Barbour, W., "Incandescent burners." Dec. 3.
27,540.—Douglas, J. T., "Suction gas-producers." Dec. 4.
27,596.—Walther, R. E., "Atmospheric burner." Dec. 4.
27,641.—Cox, F. J., "Gas-making plants." Dec. 4.
27,675.—Horne, C. H., "Gas-heating regulator." Dec. 5.
27,794.—Specht, P., and Schnurr, T., "Incandescent burners." Dec. 6.
27,896.—Blood, A. T., "Torch-shaft for street lighting." Dec. 7.
27,908.—Grafton, W., "Removal of naphthalene from illuminating gas." Dec. 7.
27,965.—Hartley, W., "Petrol-gas burners." Dec. 8.
27,967.—Ickringill, I., and Helliwell, J., "Mantles" Dec. 8.
27,976.—Brierley, J., "Incandescent burners." Dec. 8.
27,990.—Guy, J. P., "Gas-fired kilns." Dec. 8.
28,007.—Webber, J., "Gas-fittings." Dec. 8.
28,033.—Harwood, B. E, "Regulator for incandescent gas-burners." Dec. 8.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

Foreman. Gosport Gas and Coke Company.
Assistant Engineer and Manager. Preston Gas Company. Applications by Jan. 8.

Vacancy for Pupil.—No. 4684.

Situation Wanted.

Representative (Gas Stove Trade). Gray, Chorlton-cum-Hardy.

Plant for Sale.

Lamp-Pillars. Neath Gas Department.

Stocks and Shares.

South Metropolitan Gas Company.

TENDERS FOR

Brass Cocks, &c.
Nottingham Gas Department. Tenders by Dec. 20.

Coal and Cannel.
Copenhagen Lighting Department. Tenders by Jan. 3.
Crays Gas Company. Tenders by Dec. 31.

Fire-Clay Goods.
Nottingham Gas Department. Tenders by Dec. 20.
Rochdale Gas Department. Tenders by Dec. 26.

Gasholder (Telescoping).
Teignmouth Gas Department. Tenders by Dec. 8.

General Stores, Paints, Oils, Forks, Lead, Steel Goods, &c., &c.
Nottingham Gas Department. Tenders by Dec. 20.

Lime.
Nottingham Gas Department. Tenders by Dec. 20.

Meters, &c.
Nottingham Gas Department. Tenders by Dec. 20.

Pipes, &c.
Nottingham Gas Department. Tenders by Dec. 20.

Retort Fittings, &c.
Nottingham Gas Department. Tenders by Dec. 20.

Tar and Liquor.
Bridgewater Collieries Coke Works. Tenders by Dec. 20.
Enfield Gas Company. Tenders by Dec. 29.
Gravesend and Milton Gas Company. Tenders by Jan. 1.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

CHRISTMAS HOLIDAY.

In consequence of the CHRISTMAS HOLIDAYS, it will be a convenience if Communications for the next issue of the "JOURNAL" and Orders respecting ADVERTISEMENTS are received at the Office SOME TIME ON SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

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Payable in Advance. If credit is taken, the charge is 25s. a year.
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All Communications, Remittances, &c., to be addressed to Walter King, 11, Bolt Court, Fleet Street, London, E.C.
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O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
Palmerston House,
Old Broad Street, London, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
Andrew Stephenson, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism London."

BROTHERTON & CO., LIMITED.
Offices: Commercial Buildings, Leeds.
Correspondence invited.

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SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness, with efficiency for Repairs.
Joseph Taylor and Co., Central Plumbing Works, Bolton.
Telegrams: Saturators, Bolton. Telephone 0848.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, Oldham, and 54 & 47, Westminster Bridge Road, London, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.
Repairs receive prompt attention.
Telephones: 254 Oldham, and 2412 HOP, London.
Telegrams:—
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SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.
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Telephone: 341, Avenue.

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Works: Birmingham, Leeds, Wakefield, and Sunderland.

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Contractors for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, ROSE MOUNT IRON-WORKS ELLAND.

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CARBURINE FOR GAS ENRICHING.
ALSO
THE MAXIM PATENT CARBURETTOR.
For Prices, &c., apply to
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7, BISHOPSGATE STREET WITHOUT,
LONDON, E.C.
Telegraphic Address: "Carburine, London."

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PUBLICATIONS, "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; "SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 and 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

GAS TAR wanted.
BROTHERTON AND CO., LTD., Tar Distillers. Works: BIRMINGHAM, GLASGOW, LEEDS, LIVERPOOL, WAKEFIELD, AND SUNDERLAND.

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OVER 3000 INSTALLATIONS IN DAILY USE.
SEE illustrated advertisement in next week's issue.
JAMES KEITH AND BLACKMAN CO., LTD., 27, Farringdon Avenue, LONDON, E.C.

INCREASE YOUR MAKE.
SEND for Particulars of the "RAPID" Carburettor. Why be short of Gas when you can stretch the make from 1000 to 2000 cubic feet per ton, without any difficulty?
BIGGS, WALL, & Co., 13, Cross Street, Finsbury Pavement, LONDON.

TAR AND LIQUOR WANTED.
Best Prices paid.
DENT AND CO.,
Ouse Chemical Works, SELBY.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

SIMMANCE-ABADY RECORDING Thermometers, Recording Pressure Gauges, and CO_2 Recorders, &c.
ALEXANDER WRIGHT & CO., LTD.,
1, WESTMINSTER PALACE GARDENS, ARTILLERY ROW,
VICTORIA STREET, WESTMINSTER, S.W.

GAZINE—A radical Solvent and Preventative of Naphthalene deposits, and the Automatic cleaning of Mains and Services.
It is also used for the Enrichment of Gas, and has an illuminating value double that of 90 per cent. Benzol.
Supplied by C. BOURNE, West Moor Chemical Works, KILLINGWORTH, or through his Agent, F. J. NICOL, Pilgrim Street Chambers, NEWCASTLE-ON-TYNE.
Telegrams: "DORIC," Newcastle-on-Tyne. National Telephone No. 2497.

TEMPERLEY TRANSPORTERS
FOR Rapid and Economical Handling of Coal and Coke in Gas-Works.
Next Illustrated Advertisement will appear on Dec. 25.
TEMPERLEY TRANSPORTER COMPANY,
72, BISHOPSGATE STREET WITHIN, LONDON, E.C.
Telephone: 365 LONDON WALL. Telegrams: "TRANSUMO."

GAS-STOVE TRADE, &c.
HERBERT C. GRAY, who has represented Messrs. R. & A. Main, Limited, of Falkirk, for the past Nine Years, has tendered his resignation, and is open for RE-ENGAGEMENT Jan. 1.
Address No. 43, Claude Road, Chorlton-cum-Hardy, MANCHESTER.

THE Engineer of a large Gas-Works with modern equipment has a VACANCY for a PUPIL. Moderate Premium, returned in Salary. Good Education, and some aptitude for Chemistry and Drawing essential.
For further Particulars, apply to No. 4684, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOREMAN wanted at once. Gas-Works training essential. Must be steady and content to supervise and control men on the Works; also Main and Service Layers. Wages 32s. 6d. per week.
Applications, by letter, stating Age, Experience, and References, to the GENERAL MANAGER, Gosport Gas and Coke Company, GOSPORT.

PRESTON GAS COMPANY.
WANTED, by the above Company, an ASSISTANT ENGINEER and MANAGER. Salary, £350 a Year, off which is deducted 3 per cent. for Superannuation.
Applications, stating Age, Qualifications, and Experience, with Testimonials, must be received by the undersigned not later than Tuesday, the 8th of January, 1907.
HENRY GREEN,
Engineer and Secretary.

PURIFIERS wanted, 10 feet, 12 feet, and 15 feet square Boxes. Gasholders up to 100,000 cubic feet capacity. Every description of Plant bought and dismantled. Scrap Buyers of old Meters, Brass, Copper, and other metals for Cash.
State Particulars and Quantities to FIRTH BLAKELEY AND CO., Gas Plant Buyers, DEWSBURY.

CORPORATION GAS-WORKS, NEATH.
FOR SALE.—About 120 Lamp-Pillars.
All Particulars from the MANAGER.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters. Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

TO TAR DISTILLERS.
THE Directors of the Enfield Gas Company invite TENDERS for the Surplus COAL-GAS TAR to be produced at their Works, Ponders End, Middlesex, between the 1st of January, 1907, and the 31st of December, 1907.
Approximate quantity, 150,000 Gallons.
Tenders, stating price per Gallon in Purchaser's Tank Waggons, marked "Tar," to be delivered, on or before the 29th curt., to the undersigned.
CHARLES W. OFFORD,
Secretary and General Manager.

TENDER FOR TAR.
THE Directors of the Gravesend and Milton Gaslight Company are prepared to receive TENDERS for the Surplus TAR made during the Year ending Dec. 31, 1907.
The probable quantity will be about 60,000 Gallons.
Conditions and Form of Tender can be obtained of the undersigned.
Endorsed Tender, addressed to the Chairman of the Company, must be sent to me not later than Jan. 1 prox.
The Directors do not bind themselves to accept the highest or any Tender.
JOSEPH DAVIS,
General Manager.
Dec. 10, 1906.

BRIDGEWATER COLLIERIES COKE-WORKS.
(THE EARL OF ELLESMERE.)
TENDERS are invited for the Tar produced at the above Works for a period of Six or Twelve Months from the 1st of January, 1907, delivered into Contractor's Tanks at the Bridgewater Colliery Siding, Wharton Hall, on the Pendleton and Hindley Branch of the Lancashire and Yorkshire Railway; or at the Brackley Siding, Little Hulton Mineral Branch, of the London and North-Western Railway.
The estimated quantity is about 2600 Tons per annum.
Tenders, endorsed "Tender for Tar," to be addressed to Mr. THOMAS M. BROWN, Bridgewater Coal Offices, 4, Chapel Walks, MANCHESTER, not later than the 20th of December.
Manchester, Nov. 27, 1906.

TEIGNMOUTH URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)
THE Urban District Council of Teignmouth invite TENDERS for TELESCOPING an 80 feet GASHOLDER.
The Drawings may be seen, and copies of the Specification obtained, on application to the undersigned, to whom a payment of One Guinea must be made. Same will be returned on receipt of a *bonâ-fide* Tender.
The Council do not bind themselves to accept the lowest or any Tender.
Sealed Tenders, endorsed "Gasholder," and addressed to A. Percival Dell, Esq., Clerk to the Council, Town Hall, Teignmouth, to be delivered not later than Ten a.m. of Tuesday, the 8th of January, 1907.
J. ALEX. GRAY,
Engineer and Manager.
Gas-Works, Teignmouth,
Dec. 14, 1906.

COUNTY BOROUGH OF ROCHDALE.
TO FIRE-BRICK MAKERS AND OTHERS.
THE Gas Committee of the above Corporation invite TENDERS for the Supply of such quantities of FIRE BRICKS, BLOCKS, TILES, &c., as they may require during a period of Twelve Months, ending the 31st of December, 1907.
Forms of Tender may be obtained on application to Mr. T. Banbury Ball, the Manager, at the Gas-Works.
Tenders, endorsed "Fire-Clay Goods," must be sent in to me not later than noon on Wednesday, Dec. 26, 1906.
By order,
WM. HENRY HICKSON,
Town Clerk.
Town Hall, Rochdale,
Dec. 14, 1906.

CRAYS GAS COMPANY.
THE Directors of the above Company are prepared to receive TENDERS for the supply of 15,000 Tons (more or less) of the Best GAS COAL, to be delivered at the St. Mary Cray Railway Station at such times and in such quantities as the Company shall require.
Forms of Tender containing Particulars and Conditions of the Contract may be obtained on application to the undersigned.
Sealed Tenders, endorsed "Tender for Coal," addressed to the Chairman of the Directors, The Crays Gas Company, to be sent to the undersigned on or before the 31st of December, 1906.
By order,
W. B. MIMMACK,
Secretary.
Gas-Works, St. Mary Cray,
Kent, Dec. 8, 1906.

TENDERS FOR GAS COAL.
THE Lighting Department of Copenhagen is prepared to receive TENDERS for the supply and delivery of 175,000 Tons of BEST GAS COAL from the beginning of March until the end of December, 1907.
The Lighting Department reserves the right to divide the Contracts between two or more Contractors.
Further Information and Conditions for the delivery may be obtained on application to Direktoren for Kôbenhavns Belysningsvæsen, Raadhûset, Copenhagen, B.
The Tenders, sealed and marked "Tilbud paa Kul," to be sent to Direktoren for Kôbenhavns, Belysningsvæsen, Raadhûset, Copenhagen, B., before the 3rd of January, 1907, Twelve o'clock, at which time the Tenders will be opened in the presence of the parties tendering who are in attendance.
THE LIGHTING DEPARTMENT OF COPENHAGEN,
Dec. 10, 1906.

CORPORATION OF NOTTINGHAM.
(GAS DEPARTMENT.)
THE Gas Committee are prepared to receive TENDERS for the supply of the whole, or a portion, of their requirements of the following GOODS and MATERIALS, for delivery during the ensuing Year, carriage paid at their various Gas Stations, Chemical Works, or Stores, or at any Railway Station within the Nottingham gas supply district:—

(*a*) Cast-Iron Pipes and Specials.
(*b*) Pig Lead, Lead and Compo. Pipe, White, Red, and Chemical Sheet Lead.
(*c*) Wrought-Iron and Steel.
(*d*) Retorts and Fire Materials.
(*e*) Meters (Wet, Dry, and Prepayments.) Also repairs.
(*f*) Wrought-Iron Tubes and Fittings.
(*g*) Brass Cocks and Malleable Iron Levers.
(*h*) Small Iron Castings, Retort Fittings, &c.
(*i*) Purchase of old Cast and Wrought Scrap Iron, old Copper, Brass, &c.
(*j*) Lime for Purification, and Chemical Works purposes.
(*k*) Paints.
(*l*) Oils.
(*m*) Rope Yarn.
(*n*) Tallow.
(*o*) Cotton Waste.
(*p*) Coke Forks, Shovels, Buckets, Files, &c.
(*q*) Meter Boxes, Platforms, and Shelves.

Specifications and Forms of Tender may be obtained, and samples seen on application to the Engineer and General Manager, at the Gas Offices, George Street, Nottingham.
Tenders to be addressed to me and delivered at the Guildhall, Nottingham, not later than Thursday, the 20th day of December.
The Gas Committee do not bind themselves to accept the lowest or any Tender.
By order,
SAMUEL G. JOHNSON,
Town Clerk.
December, 1906.

HORNSEY GAS COMPANY.
NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, relating to DEBENTURE STOCK ONLY, WILL BE CLOSED on the 17th inst., and RE-OPENED on the 1st of January, 1907.
By order of the Board,
WILLIAM E. ROBERTS,
Secretary.
63, Chancery Lane, W.C.,
Dec. 17, 1906.

SOUTH METROPOLITAN GAS COMPANY.
NOTICE is Hereby Given, that the Directors of this Company will OFFER the sum of £100,000 ORDINARY STOCK "to all the Gas Consumers and persons in the employ of the Company," pursuant to the provisions of the South Metropolitan Gas Act, 1901.
Full Particulars thereof, together with the Price of such Stock, will be sent to the consumers with the Gas Accounts for the Christmas quarter.
By order,
FRANK BUSH,
Secretary.
Offices: 709, Old Kent Road, S.E.,
Dec. 8, 1906.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.
MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
Terms for Issuing such Capital, and also for including in these Periodical Sales Gas and Water Stocks and Shares belonging to Private Owners, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.